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CONTENTS

Car Department Competition

The first prize of $50 in the car department competition which closed October 15, 1914, has been awarded to Robert P. Blake, master mechanic of the Northern Pacific at Dilworth, Minn. Mr. Blake's article consists of a practical discussion of the most important weaknesses or defects in box cars, and will be found on another page of this issue. Several of the other contributions have been accepted for publication, and one article in particular is deserving of special mention. It was prepared by Robert N. Miller, instructor in mechanical engineering at the Carnegie Institute of Technology, Pittsburgh, Pa., and discusses at length the defects of modern box cars and the remedies. It will be published in an early issue.

Efficient Cleaning of Locomotives

An item of economy in locomotive maintenance that should be called more forcibly to the attention of those interested in this work is the cleaning of locomotives with a mixture of oil and water. This process was mentioned at both the General Foremen's and the Master Painters' conventions which were held within the past few months. One road claimed a saving of over $100 per engine per year by its use. The Delaware, Lackawanna & Western uses a mixture of 150 gal. of hot water to 1 gal. of crude oil. This mixture is sprayed through nozzles, compressed air being used as the driving force. It requires about 18 min. to each engine at an average total cost of 30 cents. Other roads reported a cost per engine as low as 15 cents, stating that when the work is done on a piece work basis the operators will make from $80 to $85 per month. It is not necessary to employ expensive labor as the work requires no unusual intelligence. This process not only gives the engine and tender a clean and neat appearance, but makes it possible for the inspectors to detect defects that would otherwise be overlooked.

Journal Box Packing

Experiments with car journals have shown that the co-efficient of friction with the surfaces efficiently lubricated is from one-sixth to one-tenth that for dry or scantily lubricated surfaces. This means that if one journal on a car is dry or scantily lubricated the power required to move it is approximately that required to move two similar cars efficiently lubricated. Carrying this to extremes, if on one road one journal of each car were absolutely neglected, twice as many locomotives would be required to haul the traffic as would be needed if all journals were maintained in an efficient condition. The same limitations will apply if all the car journals are only maintained to 87.5 per cent of their efficiency. In addition to the power losses there is the loss in time to trains on the road and the damage to equipment on account of hot boxes.

Regardless of the correctness of the above figures the time and money spent in properly maintaining journal boxes is very much worth while. This is becoming more generally recognized by many roads that have established definite intervals at which the journal boxes are to be carefully inspected and overhauled, and until it is the general practice of all roads to do this it cannot be expected that the journal box situation will approach the 100 per cent efficiency mark. Some roads that have followed this practice operate plants to reclaim what is possible from the old packing. One road, as reported at the 1912 convention of the Railway Storekeepers' Association, reclaimed 4,223 lb. of babbitt metal and 171,227 lb. of serviceable waste from 262,548 lb. of old packing at a cost of $0.37 per 1,000 lb. of the old material. Such procedure would partly compensate for the extra work necessitated by the periodic inspections.

The men entrusted with the maintenance of journal boxes should be carefully instructed as to the proper methods for doing this work. The statements made by car men in papers on this subject before the Missabe Railway Club and the Car Foremen's Association of Chicago show that the point most

overlooked in packing journal boxes is the back of the box; as O. J. Parks stated in a paper before the latter club—"Look out for the back of the box, this is the big bug."

Reducing Water Stops

A subject which should be of interest in connection with the use of superheaters on locomotives is the possibility of reducing the number of stops for water. We do not know to what extent the introduction of the superheater has affected the number of stops for this purpose, but it would seem to be an important consideration. In freight service the increased boiler capacity obtained by the use of the superheater is generally pretty well absorbed by an increase in trainload; this is also true in passenger service, but not to the same extent, as in this service the superheater locomotives are more generally employed because of a lack of ability on the part of the saturated steam locomotives to successfully cope with the trains. Of course, if a train is scheduled to stop at a water station the engine crew are more than likely to fill the tank at that point; they are then running less risk of being short of water in case of engine failure or delays further along. But on trains which make long runs without stops there would seem to be possibilities of saving by running the superheater locomotives by water stations at which it was necessary to stop when saturated steam locomotives were used. Just what this saving would amount to it is difficult to say; it would probably not be practicable to eliminate many, if any of the water stations, because of the freight service and the necessity of providing water for smaller locomotives. There is so much variation in conditions that it is impossible to arrive at any very definite conclusion, but it would seem that at least there might be a saving in the expense for pumping.

The Treatment of Subordinates

We have at times had occasion to call attention to what has been aptly termed "unintelligent rawhiding," the method followed by some railway officers in dealing with their subordinates, particularly in correspondence. It seems incomprehensible that a superintendent of motive power will treat a man whose intelligence and ability he considers great enough to warrant his appointment as master mechanic of a division, in a manner which should arouse criticism if assumed toward a ten-year-old child, but any railroad man of however little experience knows that this is often the case. A short time ago, in reply to an explanation on his part, of an engine delay for which he was not responsible, a foreman received from his master mechanic a telegram which began "Cannot believe your explanation." The master mechanic would not have made this statement verbally outside the privacy of his own office, yet he did not hesitate to include it in a telegram which besides being read by the sending and receiving operators, was given careful attention by the boy who carried it from the telegraph office to the engine house, by two clerks in the engine house office and by the call boy who finally carried it to the foreman, who was out of the office at the time. Its contents were, of course, known throughout the engine house in a very short time.

Every one is familiar with the argument advanced by the authors of such correspondence that it is necessary to sometimes "go after a man hard" in order to keep before him the realization of his responsibilities. This line of reasoning, if it can be dignified as such, has long since gone out of date and its employment at the present stage of railroad work does not indicate great intelligence on the part of the man advancing it. The wonder is that very often the officer who makes use of this argument is the first to admonish his subordinates to use every care in their treatment of the men under them. Why a foreman or a master mechanic is not entitled to just as courteous treatment as a machinist or boilermaker is hardly apparent, and the more such officers receive this "rawhiding" the more likely they are to cause trouble and dissension in the ranks by taking it out on the men under them. There is not enough attention given to the matter of courtesy in railroad correspondence; the higher officers are largely to blame for this condition and can do much to eliminate it.

End Construction in Box Cars

Attention has repeatedly been called to the weakness of the end construction of a great many of the box cars now in service. In some of the more modern cars the weakness is not so much in the members of the end frames themselves as in their connection to the other members of the car framing. An example of such weakness may be seen in the car with end posts consisting of heavy I-beams or Z-bars connected to end sills and end plates by one or two rivets or some similar attachment, the strength of which is a mere fraction of the strength of the post itself. In designing steel passenger train cars a great deal of attention has of necessity been given to the end construction in order to avoid telescoping in case of collision. Heavy end posts, both in the body end and the vestibule, are employed and special pains are taken to connect them to the underframe and through the end plate to the side frames; these points are deserving of careful consideration in the designing of box cars. A box car with ends that are put out of service with the first heavy shock or shifting of the load, is not of much use in the moving of traffic under present day conditions and end construction in this type of equipment can be greatly improved by more care in connecting the end and corner posts to the end sill, and the end sill to the underframe, and also, by providing a substantial end plate with corresponding connections between it and the upper ends of the posts. Careful consideration should also be given to connecting and bracing the end plates to the side framing of the car. Heavy wooden sheathing or a steel plate extending the width of the car and covering the greater part of the end is of material assistance in strengthening the end structure, but particular attention should be given to its connection to all of the end posts in order that it may help in distributing shocks over the entire end frame, mitigating as much as possible the strains to be borne by individual posts.

Co-operation and the Stores Department

In considering the desirability of co-operation between departments in railroad work, it is perhaps natural that the operating and mechanical departments should come first to mind. The business of a railroad is to provide transportation, and in this the motive power, car and operating departments are most directly concerned. However, co-operation or lack of it on the part of the stores department may have a very direct bearing on transportation costs. Severe censure is poured out on the head of the mechanical department man who fails to realize that his first attention always should be to provide the operating department with locomotives. He becomes so absorbed in his own department that he forgets that his duty is not to repair locomotives, but to repair locomotives so that they may be used in moving trains; but this applies also to the storekeeper. There is a tendency on the part of some members of the stores department organization toward a narrow view of their part in the transportation problem.

The stores department man who keeps mechanics standing around awaiting his pleasure is well known; he either does not realize, or does not care, that while he is apparently putting a machinist or a boilermaker in what he considers his proper place by making him await the pleasure of the stores department, he may be delaying material that will in turn delay a locomotive and hold up several trains. Then there is the storekeeper who insists on following the most roundabout way in getting a casting or other heavy material for which a locomotive is being held out of service. It is not intended to be-

little his efforts to have a correct record of all material which passes through his hands; this is a necessity, but it can still be accomplished and time very often saved to the mechanical and operating departments by a little extra effort on his part or that of his subordinates. Stores department men are often prone to think of themselves as detached from the hustle and bustle of moving trains, but a little careful consideration will bring them to realize that they have a very direct part in it and that their co-operation with other departments is not only desirable but essential.

Purchasing Material

There are many instances in which the specification of material is left entirely to the purchasing agent and the selection made on the basis of first cost, when from the standpoint of economy it might better be selected according to the recommendations of the officers in the department using the material. This statement undoubtedly applies in a restricted sense to the larger railway systems having test departments charged with the preparation of specifications for certain materials and the selection of others from the results of service trials. There are many roads, however, too small to maintain departments of this nature, on which the selection of materials is left very largely to the discretion of the purchasing agent. In the absence of data as to the comparative serviceability of different qualities, the material having the lowest first cost is very frequently selected, even though the aggregate expenditure in the course of a year is much greater than would have been the case if a better but more expensive quality had been secured. There are cases where such practices may be followed by the purchasing department even against the protest of the department using the material, but the fault does not lie wholly with the purchasing department. It is largely due to the lack of adequate records showing the actual service performance of various classes of material and devices, especially in the motive power department. While officers of this department may have well defined opinions as to the best quality of material for a certain use based upon general observations, such opinions do not carry the weight that would be accredited to them were they backed by adequate service records. The clerical work necessary to keep these records undoubtedly involves some expense and requires careful consideration to insure that time is not wasted in gathering useless information. But, if properly kept, the returns from them will be far greater than the expenditure. The question of keeping such records is one which should be given careful study by motive power department officers.

High Power Pacific Type Locomotive

According to our records the Pacific type locomotive for the Chesapeake & Ohio, described elsewhere in this issue, is the most powerful, as well as the heaviest, locomotive of this type yet built. The total weight of this engine is 312,600 lb., and it will develop a maximum tractive effort of 46,600 lb. A Pacific type locomotive recently built by the Baldwin Locomotive Works for the Carolina, Clinchfield & Ohio, and described in the *Railway Age Gazette* of November 27, 1914, page 1005, has practically the same maximum tractive effort, but the steam pressure is 200 lb. per sq. in., against 185 lb. for the Chesapeake & Ohio locomotive, the cylinders being 25 in. by 30 in. against 27 in. by 28 in.; the driving wheels are 69 in. in diameter in both cases. As will be seen by the table accompanying the description of the Chesapeake & Ohio locomotive there is considerable difference between these two engines in point of sustained capacity, the boiler of the Chesapeake & Ohio engine being considerably larger, resulting in a total heating surface of 4,478 sq. ft. against 3,982 sq. ft. in the Clinchfield engine. A comparison of the Chesapeake & Ohio locomotive with the Pennsylvania Railroad's Pacific type, class K-4-s is also of interest. The tractive effort of the Pennsylvania locomotive is 41,800 lb., and the total weight 312,000 lb., while the weight on drivers is 200,000 against 191,400 lb. in the case of the Chesapeake & Ohio. Again the boiler is considerably larger, the new locomotive having tubes 18 in. longer than the Pennsylvania locomotive, while the diameter at the front end is 5 in. greater than the Pennsylvania boiler. The total heating surface of the Pennsylvania and Clinchfield locomotives is almost the same, but taking the superheater into consideration the total equivalent heating surface is 5,965 sq. ft. for the Chesapeake & Ohio locomotive, 5,414 sq. ft. for the Clinchfield and 5,756 sq. ft. for the Pennsylvania K-4-s. The boiler pressure of the Pennsylvania locomotive is 205 lb. In the Chesapeake & Ohio locomotive the ratio of total weight to maximum tractive effort is 6.72; in the case of the Carolina, Clinchfield & Ohio locomotive this figure is 6.09; in the Pennsylvania it is 7.28; in the American Locomotive Company's experimental locomotive No. 50,000 it is 6.68, and in the Chesapeake & Ohio Mountain type locomotive, built in 1911, it is 5.69.

Mechanical Department Appropriations

There is room for considerable improvement in the assignment of appropriations in the mechanical department. We have in mind a case which was especially bad and while it is improbable that such poor reasoning is followed in very many instances it provides an example of how illogically this problem is sometimes attacked. A new terminal was opened and the foreman informed that his appropriation for the month would be $1,000. He made an estimate of the probable expenditures for the month and found that even with the most rigid economy they would not be less than $1,800; he wrote to the master mechanic protesting against the low appropriation and enclosing an analysis of the necessary payroll expenses. This letter was ignored. By laying off a number of men, avoiding all overtime and slighting considerable important repair work he managed to get through the month with a payroll total of $1,780. It is not necessary to dwell on the correspondence that followed beyond the fact that not one of the foreman's arguments was answered by his superior; but the next month's appropriation was again $1,000. This was continued for several months, the expenditures running from $500 to $750 over the amount allotted. The same discussion by correspondence took place each month, varied only by a veiled intimation that it might be necessary to change foremen at that particular terminal. Suddenly, without a word of explanation being given, the appropriation was increased to $1,500 and the month following to $2,000; the reason for this increase was that pressure had been brought to bear on the mechanical department because of the large number of engine failures chargeable to this terminal, but this fact did not become known until later. As a matter of fact, the power was in such condition that it was then impossible to put it in shape without exceeding even this last appropriation, and this was the case for three months.

There are several points worth considering in the foregoing, but the most important would seem to be the relation between engine house appropriations and engine failures. The master mechanic in this case did not look beyond actual payroll expenditures. Like a great many others he told his foremen "You must give more attention to *this;* more time will have to be given to keeping up *that* particular line of repairs; we are having too many engine failures." But more time spent on terminal repairs means more men, and more men means more money; the mere issuing of instructions will not carry out the work of repairs. The difficulty is in getting mechanical department officers to see beyond expenditures which come directly under their own attention; it is difficult to make an accurate estimate of the cost of an engine failure, but it is safe to say that it is almost invariably greater than the cost of making the repairs that would have prevented it. Cutting appropriations to an unreasonable extent in order to reduce maintenance expenses on locomotives is and always has been ex-

pensive economy. Engine failures cause expenses and annoyance, the results of which may be in evidence for months after the occurrence and the easiest way to prevent them is by thorough repairs at terminals. This means an engine house appropriation large enough adequately to cover the necessary expense. After all, the matter of appropriation resolves itself mainly into first consideration being given by officers and employees of all departments, not to their own immediate departmental difficulties, but to the broader problem of the economical movement of trains.

NEW BOOKS

Thermal Properties of Steam. By G. A. Goodenough, Professor of Thermodynamics, University of Illinois. 69 pages, 6 in. by 9 in. Illustrated with diagrams. Bound in paper. Published by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Price 35 cents.

This bulletin presents a critical discussion of the experimental investigations of the various thermal properties of steam, an outline of the thermodynamic relations that must be satisfied, and finally the development of a general theory of superheated and saturated steam. As a basis for such a theory the Munich experiments on specific volumes and specific heats are taken and properly correlated through the Clausius relation.

Foremen and Accident Prevention. 80 pages, 4 in. by 6 in. Bound in paper. Published by the Travelers Insurance Company, Hartford, Conn.

This book is intended to be studied in connection with a companion booklet previously issued by the Travelers Insurance Company and entitled The Employee and Accident Prevention. The earlier one takes up the subject from the standpoint of the worker, who has but little power to modify the conditions under which the work is done, while the present one approaches it from the point of view of the executive and administrative departments and gives suggestions with regard to the management of the workers and the improvement of the plant with a view to increased safety.

Railway Rolling Stock Appliances and Equipment. Compiled and arranged by Parker Cook, Victor Building, Washington, D. C. 16 pages, 3¾ in. by 6 in. Bound in paper. Copies free.

Patent attorneys receive numerous inquiries from clients as to the number of patents in the different sub-classes, and so far as is known there has been up to the present no publication that gives this information. This book gives the number of patents in each class and sub-class and was compiled after considerable research work. It is so arranged that an inventor or any one desiring such information can at once determine how many patents there are in any sub-class. It should prove of particular value to inventors, as they can determine at once from it how many patents there are in the various sub-classes.

The Science and Practice of Management. By A. Hamilton Church. 535 pages, 4¾ in. by 7¼ in. Illustrated with charts. Bound in cloth. Published by the Engineering Magazine Company, 140 Nassau street, New York. Price $2.

This book constitutes the latest addition to the Works Management Library of the Engineering Magazine. The author's treatment of the subject seems to be scientific, not in the sense that he sets forth any system of so-called scientific management, but that he attempts in a scientific way to get at the fundamental elements and principles, so that existing forms of management can be scientifically analyzed and classified. It has been endeavored to ascertain the fundamental facts of production, not from the viewpoint of cost but from the viewpoint of management. Instead of trying to throw light on the nature of expense the author has endeavored to throw light on the nature of organization. The book is an attempt to formulate such fundamental facts and regulative principles as may be later developed into a true science of management, and is not one from which the "rule of thumb" practitioner can obtain a ready-made system.

COMMUNICATIONS

UNIFORM STENCILING OF FREIGHT CARS

WHISTLER, Ala.

TO THE EDITOR:

The uniform stenciling of freight cars has been discussed by the Master Car Painters' Association for several years for the purpose of simplifying this feature of foreign car repairs and to expedite their movement through the various repair yards, but thus far little has been accomplished. The matter of standardizing all lettering relating to the dimensions and equipments of freight cars of all classes is perfectly feasible. At present the size of the letters used on the cars of the various roads varies from ¾ in. to 3 in. in height, and there is no reason why these should not be standardized in order to facilitate the work of relettering whenever repairs make it necessary. This part of the cost of stencil making for foreign cars, which is considerable in many instances, could be entirely obviated by standardizing. A feasible plan for effecting this change is to have the Master Car Painters' Association submit a suitable style and size of letter to the Master Car Builders' Association for approval and adoption, then a blue print copy showing style and full size of letters should be made, and a copy furnished each company with a request that it be put into effect on all new and repainted equipment.

J. H. PITARD.

THE DRAFT GEAR PROBLEM

CHICAGO.

TO THE EDITOR:

I noticed a communication in your September issue, page 453, entitled "Spring versus Friction Draft Gears." Knowing, as I do full well, the policy of your journal to publish facts, and not near facts or misrepresentation of facts, I am prompted to write you as I do on this subject.

I have noted that the writer of the communication says about the "home dog" and the "tramp dog." I don't just see what either dog has to do with the freight car or the draft gear, except that most cars "go to the dogs" for want of efficient gears. The writer refers to the "essential points" of a draft gear, one of which is the "initial resistance to permit an easy starting of the train." When all of our cars are equipped with high capacity friction draft gears, and all the cars are new, it will be time enough to talk about "initial resistance." At the present time, and in the present condition of freight car equipment, we have all the natural slack that we need, due to wear and tear, to permit the starting of any train.

I am willing to admit that "there is a vast difference between a mechanical engineer and a railway switchman," but I am unwilling to admit that the "former takes one single gear into the laboratory and takes the time necessary to very carefully and gently compress it." The days of the static tests have gone by. Railroad men are not testing out their draft gears in this manner. Such a test has been discarded, and in its place has come the drop hammer test. Static tests of draft gear have been so far and long superseded by other tests that it is almost a joke to refer to them at the present time. We must admit that the railway switchman is not always a careful individual, and that cars are moved and run around and sent into each other at a terrific speed, but your correspondent forgets that these shocks are to be taken care of not by a single draft gear, but by many, and that when a switchman "throws a cut of loaded cars down against other cars standing still, with the usual high sign (put them into clear), which means at speeds of from five to ten miles an hour, and sometimes more," the resulting shock is not put upon one draft gear, but upon many. A great many men, in figuring the amount of energy developed, immediately come to the conclusion that one single draft gear cannot stand it, forgetting that

one gear does not have to stand it, but simply that one of many gears has to stand its proportion of the shock. For example, if four cars are sent against four other cars at a certain rate of speed, when the two lots of cars come together the shock of meeting is not taken up by one draft gear, nor even by two draft gears, viz.: the two back of each of the two couplers that come together. In the eight cars taken as an example, there are of course sixteen draft gears, and all but two of these draft gears come into play, leaving fourteen draft gears to take up the shock.

After proving that no one draft gear manufactured can withstand some of the very heavy shocks (they don't have to alone), the writer of the communication states: "Thus we are forced to admit that we are unable to entirely absorb or to destroy the shocks with any kind of draft gear. The underframe must do it or the car is out of commission." No one is going to question the very great importance of a properly designed and constructed underframe, nor the fact that it must do its part in taking up the shocks or blows. We would argue always in favor of a stronger car from wheels to roof because of the punishment which cars are bound to receive in service. But when the cost of a car is so many times that of a draft gear, why not attempt to minimize as much as possible and destroy, if you can, the effects of shocks? If the underframe is to take care of the shock, and the capacity of our draft gear is to be the minimum rather than the maximum, what are we going to do with the lading? Our lading is a pretty important item. As a matter of fact that is what the freight car is built for, and in a discussion of how it should be built and how it should be protected the lading should always be given a consideration. Cars could be built to stand up in service without draft gears. We have not by any means built the strongest freight cars that it is possible to construct. Cars, of course, can take up, either in the underframe or in the car body, tremendous shocks, but unless we are to have a constantly increasing expense in the way of damaged lading we would have to pad the insides of cars or swing the lading in hammocks.

The natural thing to do when we are facing shocks in train service is to have them minimized or eliminated by the operating department, or else have them minimized or eliminated by the mechanical department. It is folly to expect to take care of them in the cars, not only on account of the car itself, but on account of the lading. The reasonable thing to do is to have the operating department insist on the greatest care in the handling of cars so as to prevent shocks, and for the mechanical department to insist upon the best appliance upon the end of a car to minimize or else destroy entirely the effects of these shocks before they can reach the car and the lading. The solution of the difficulty is in a shock destroying and not in a shock distributing draft gear.

Only with draft gear of high capacity and no recoil are we going to eliminate the break-in-two in train service. On this whole subject, we must deal with maximums and not with averages. If we could eliminate the maximum shock—to be sure of an average shock—we could build our cars to withstand them and eliminate the draft gear, so far as its protection from the effects of shock to the car is concerned, but not to the lading. However, the very fact that we are dealing with the unknown, the unusual, and the unexpected, in the blows which the car receives in service, is what makes doubly necessary the draft gear. We have to contend with maximum blows of a million pounds. We have locomotives with a tractive effort of 125,000 lb., and we have trainloads of 7,500 tons. With such equipment and rolling stock we are bound to develop energy to a large amount, and for the protection of the car, we must have something that will kill shock—not receive it, sending it back again and again in the shape of recoil.

The argument is made, in the article you published, in favor of spring gears of high capacity, the writer saying that "the greatest argument against the spring gears is a supposed recoil, but recoil we must have, or we have no draft gear." On this point I would rather quote from a man of recognized authority than simply to make a statement, and I quote from no less authority than F. B. Farmer, who, in a paper on Break-in-Twos presented at a meeting of the Air Brake Association said: "To get a high capacity by the use of more and stronger springs is now generally recognized as 'out of the frying pan into the fire,' because the greater stored up power possible with such springs adds but that much more to the forces acting to change slack suddenly." The danger of recoil in draft gear from the standpoint of trains parting is too well known by railway men to neglect it in the establishing of requirements for a draft gear. To make a draft gear successful, it must be a non-recoil shock destroyer. A spring draft gear, simply because it is a spring draft gear, must have recoil, and the higher the capacity of the springs, the higher the recoil. Mr. Farmer has probably done more road work than any other man in the United States, and when he condemns recoil, I for one must agree with him.

Reference is made to the "laboratory tests given by Mr. Newell, a nine thousand pound weight falling five and one-half inches, closing the most powerful draft spring solid, shows discrimination between spring and friction gears, as no one would use a single spring gear at this date. . . ." I take it that Mr. Newell made his comparisons between a spring draft gear and a friction draft gear, and not between a single spring and a friction gear. The most powerful spring draft gear would consist of two 8 in. by 8 in. springs with a capacity of 30,000 lb. each, which makes some difference in the comparison.

Then another statement is made to the effect that "when the springs in the ends of the cars exceed the carrying capacity of the cars, the best results are obtained," but would these "best results" be obtained at a car movement of one mile per hour, or at ten miles per hour, or between the two? Ten miles per hour is a pretty rapid movement, but I mention ten as being the maximum given by the writer of this paper.

One more point in this letter published by you; the writer says, "the resistance should be increased and the drawbar travel should be reduced." There are just two ways of increasing the capacity of a draft gear. One is to increase its size, and the other is to increase the amount of time given it to do its work. These two principles of draft gear construction are so axiomatic that it is hardly necessary to discuss them. Now, if we are to increase the amount of time to be given to the draft gear to do its work, we must increase the travel, and a draft gear having a travel of 4 in. certainly will do more work than a draft gear having a travel of 1¾ in. It has more time in which to work. It seems to me that when the writer of the communication to your column says "the resistance should be increased and the drawbar travel should be reduced," he is contradicting himself.

Bruce V. Crandall.

Draft Value.—Each quality of fuel used requires a special draft value. For run-of-mine bituminous coals an average of 0.01 in. of water is allowed for each pound of coal fired per hour. Thus two 300-h.p. boilers having a total of 106 sq. ft. of grate area and burning 20 lb. of fuel per sq. ft. per hour would require a draft of $(20 \times 0.01 \text{ in.}) = 0.2$ in. The draft actually used will generally be from two to five times that really required.—*Power.*

Strength of Drilled Steel.—Tests made in France and reported in Le Genie Civil indicate that when holes are drilled and then reamed in soft steel, the metal between the holes increases on an average of nine per cent in its ultimate strength and twelve per cent in its elastic limit. This condition is explained as being due to the fact that the metal is compressed and thus offers a higher tensile resistance to rupture. Hence, if several holes are drilled, so as not to injure the material as in punching, the average tensile strength of the section across the holes per unit area of metal will be higher than before the holes were drilled.—*Machinery.*

Most Powerful Pacific Type Locomotive

Maximum Tractive Effort of 46,600 lb. and a Boiler Which Provides High Sustained Capacity

Six exceptionally large and powerful Pacific type locomotives have recently been delivered to the Chesapeake & Ohio by the American Locomotive Company. They have a maximum tractive effort of 46,600 lb., and are believed to be the most powerful Pacific type locomotives ever built, the nearest in point of tractive effort being a locomotive of the same type, recently built by the Baldwin Locomotive Works for the Carolina, Clinchfield & Ohio. This engine has a maximum tractive effort of 46,000 lb. The Chesapeake & Ohio engines are not only exceptional in having such a large tractive effort, but also have a boiler large enough to sustain it.

These locomotives have been put in service between Charlottesville, Va., and Hinton, W. Va., a distance of 175 miles. This part of the line crosses three mountain summits: the Blue Ridge, North Mountain and the Alleghanies. To economically handle the through passenger service is a difficult problem. The mountain resorts, among which are the Virginian Hot Springs and the White Sulphur Springs of West Virginia, demand the very best of service and equipment. Trains of ten all-steel cars, weighing 674 tons, are a regular daily problem. This has required frequent resorting to double heading.

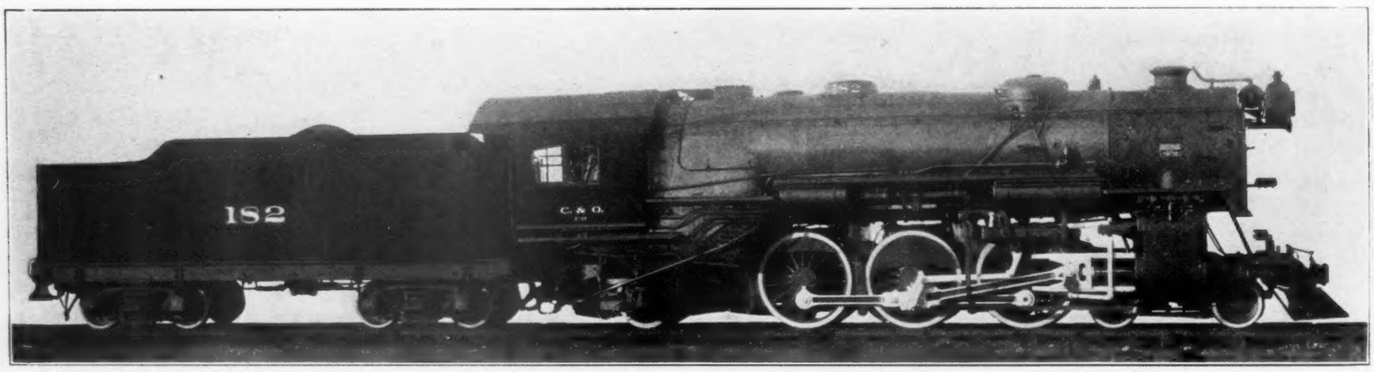
The requirements that must be met in order to make the schedule time on the Clifton Forge division are extremely difficult. Westbound from Mechums River to the summit of the Blue Ridge is a continuous uncompensated grade of 75 ft. to the mile, with curves of 10 deg., and extending a distance of 14 miles. One train of ten steel cars, weighing 674 tons, is scheduled at 22½ miles per hour on this grade, while another train of eight steel cars, weighing 551 tons, is scheduled at 29 miles per hour. From Staunton to the summit of North Mountain, a distance of 13 miles, the conditions are still more difficult. The first 6½ miles contains 4½ miles of up-grade, varying from 75 to 80 ft. to the mile, and the last 6½ miles is a continuous grade of 80 ft. to the mile. The scheduled speed for the first mentioned train is 25½ miles per hour, and for the second 35 miles per hour for this 13 miles. The schedule over the remaining part of the division permits but little time to be made up. These new engines, while as yet in service but a short time, are satisfactorily handling these trains.

It is particularly interesting to note the extent to which this railway has gone in introducing large and powerful locomotives. The Mallet, Mikado and Mountain types now in use on this road are among the most powerful of their types and have made remarkable reductions in operating costs by increasing the train-loads. The achievements of these locomotives have justified the officers in designing these large Pacifics. No innovations were attempted, but the different factors were combined to give as powerful a machine as possible within the clearances. The accompanying table gives a comparison between the Chesapeake & Ohio Pacific type and a number of other large locomotives.

	Tractive effort, lb.	Total weight, lb.	Weight on drivers, lb.	Cylinders	Diameter of drivers	Boiler diameter	Grate area, sq. ft.
C. & O. 4-6-2	46,600	312,600	191,400	27 in. by 28 in.	69 in.	83 11/16 in.	80.33
C. C. & O. 4-6-2	46,000	280,300	176,900	25 in. by 30 in.	69 in.	78 in.	53.8
Pennsylvania 4-6-2 (K-4-s)	41,800	305,000	200,000	27 in. by 28 in.	80 in.	78½ in.	70
50,000	40,800	269,000	172,500	27 in. by 28 in.	79 in.	76⅜ in.	59.75
C. & O. 4-8-2	58,000	330,000	239,000	29 in. by 28 in.	62 in.	83¾ in.	66.7

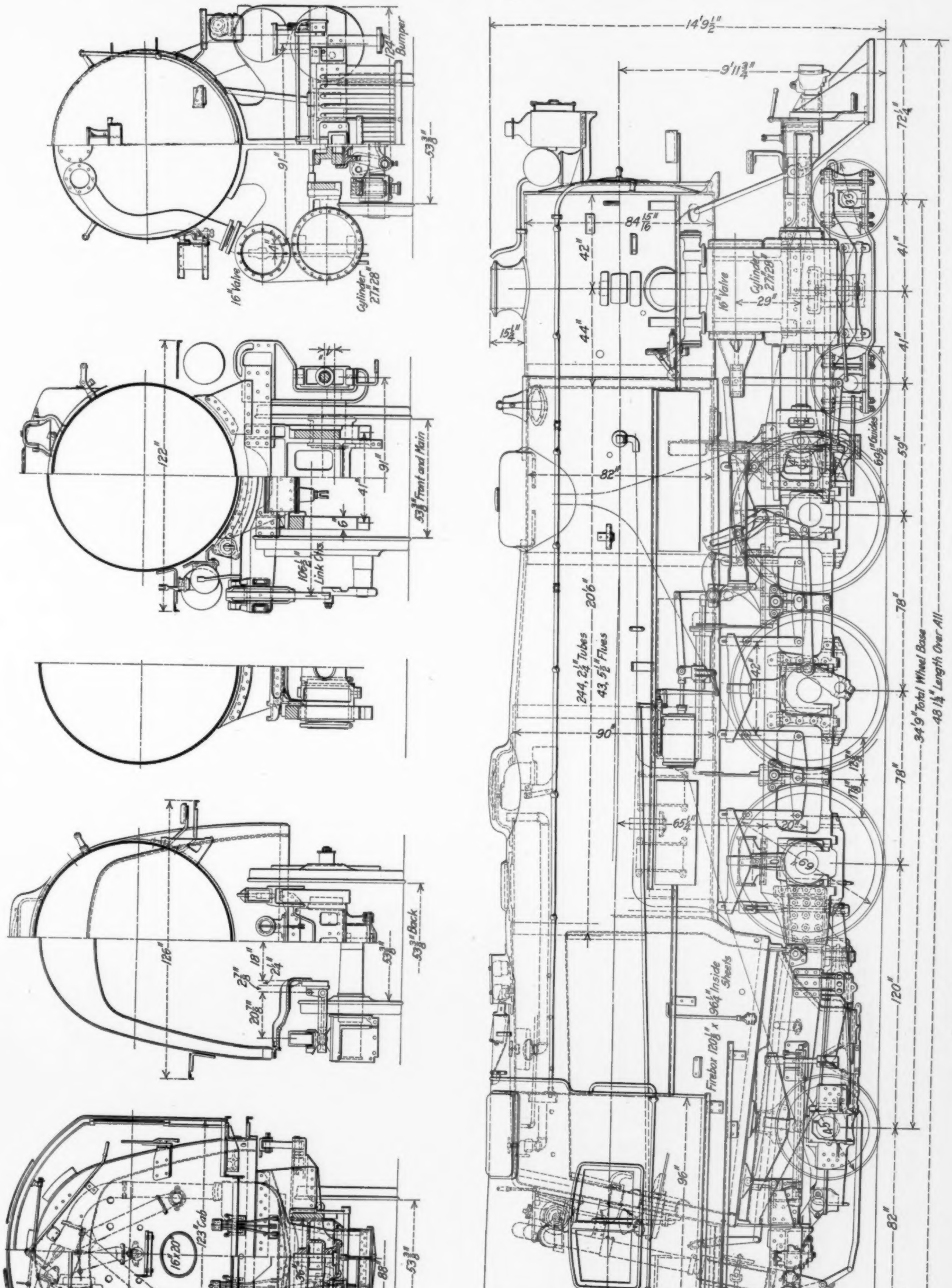
	Number of flues	Number of tubes	Length of tubes and flues,	Working pressure	Heating surface, sq. ft.	Equivalent heating surface, sq. ft.
C. & O. 4-6-2	43—5½ in.	244—2¼ in.	20 ft. 6 in.	185 lb.	4,478.8	5,965.3
C. C. & O. 4-6-2	38—5½ in.	211—2¼ in.	21 ft.	200 lb.	3,982	5,414
Pennsylvania 4-6-2 (K-4-s)	40—5½ in.	237—2¼ in.	19 ft.	205 lb.	4,035.4	5,756.3
50,000	36—5½ in.	207—2¼ in.	22 ft.	185 lb.	4,048	5,394
C. & O. 4-8-2	40—5½ in.	243—2¼ in.	19 ft.	180 lb.	4,132	5,399

The exceptional capacity of the boiler warrants special attention. It is of the extended wagon top type, and at the first course the barrel is 83 11/16 in. in diameter outside, while the outer diameter of the largest course is 90 in. The barrel is fitted with 244 tubes, 2¼ in. in diameter, and 43 flues, 5¼ in. in diameter and 20 ft. 6 in. long. The firebox is 120⅛ in. long and 96¼ in. wide, having a total depth of 82¼ in. The depth from the center of the lowest tube to the top of the grate is 25⅛ in.



Chesapeake & Ohio Pacific Type Locomotive for Heavy Passenger Service in Mountainous Country

According to the American Locomotive Company's standard system of boiler proportioning, a cylinder 27 in. in diameter using superheated steam having a pressure of 185 lb. will develop 2,427 cylinder horsepower. One cylinder horsepower requires an evaporation of 20.8 lb. of steam per hour. To develop full cylinder horsepower a total evaporation of 2,427 x 20.8, or 50,500 lb. of steam per hour is required. Boiler tubes 2¼ in. in diameter, 20 ft. 6 in. long and spaced ¾ in. give an evaporation of 8.69 lb. of steam per square foot of heating surface per hour. Boiler flues 5½ in. in diameter, 20 ft. 6 in. long,



Elevation and Cross Sections of the Chesapeake & Ohio Pacific Type Locomotive

spaced ¾ in. give an evaporation of 9.86 lb. of steam per square foot of heating surface per hour. Firebox and arch tubes give an evaporation of 55 lb. of steam per square foot of heating surface per hour. The total tube heating surface is 2,933 sq. ft., total flue heating surface is 1,263 sq. ft., total firebox heating surface is 255.4 sq. ft., and total arch tube heating surface is 27.4 sq. ft. This boiler therefore will give a total evaporation as follows:

Tubes	2,933	× 8.69 =	25,500 lb.
Flues	1,263	× 9.86 =	12,450 lb.
Firebox	255.4		
Arch tubes	27.4		
	282.8	× 55 =	15,550 lb.
Total			53,500 lb.

The total boiler evaporation, 53,500 lb. divided by the total evaporation required, 50,500, gives a 106 per cent boiler. This indicates that this engine can be worked indefinitely at its full capacity. To insure a constant supply of fuel to this boiler burning bituminous coal and having a grate area of 80.4 sq. ft., a mechanical stoker had to be applied.

The large boiler and wide firebox and the application of the stoker made the arrangement of the cab a difficult matter, and this was facilitated considerably by the use of non-lifting inspirators, Ragonnet reverse gear and the placing of the steam turret outside of and in front of the cab. Clearance restrictions made it necessary to place the bell off the center of the boiler and the headlight dynamo in front of the smoke box.

The frames are 6 in. wide and braced by box castings. The piston rod extension is the American self-centering type. Walschaert valve gear is used with the valve stem guide integral with the steam chest cover; the piston valves are 16 in. in diameter.

The special equipment includes the Schmidt superheater, Cole outside journal trailing truck, radial buffing device, American arch, Franklin pneumatic grate shaker, Cole long main driving box, Trojan packing, Vanadium steel frames and rods, Mellin by-pass valve, Hancock 5,500 gallon capacity non-lifting inspirators, Watters sanders, Nathan lubricators, Westinghouse-American driver brakes and Westinghouse-Farlow draft gear.

The following are the principal dimensions and ratios:

General Data

Gage	4 ft. 8½ in.
Service	Passenger
Fuel	Soft coal
Tractive effort	46,600 lb.
Weight in working order	312,605 lb.
Weight on drivers	191,455 lb.
Weight on leading truck	56,675 lb.
Weight on trailing truck	64,475 lb.
Weight of engine and tender in working order	497,100 lb.
Wheel base, driving	13 ft. 0 in.
Wheel base, total	34 ft. 9 in.
Wheel base, engine and tender	71 ft. 11¼ in.
Length over all	82 ft. 6½ in.

Ratios

Weight on drivers ÷ tractive effort	4.12
Total weight ÷ tractive effort	6.72
Tractive effort × diam. drivers ÷ equivalent heating surface	538
Evaporative heating surface* ÷ grate area	55.80
Equivalent heating surface* ÷ grate area	74.30
Firebox heating surface ÷ equivalent heating surface*	4.74
Weight on drivers ÷ equivalent heating surface*	32.25
Total weight ÷ equivalent heating surface*	52.30
Volume of both cylinders, cu. ft.	18.55
Equivalent heating surface* ÷ volume of cylinders	322.00
Grate area ÷ volume of cylinders	4.33

Cylinders

Kind	Simple
Diameter and stroke	27 in. by 28 in.

Valves

Kind	Piston
Greatest travel	6 in.
Outside lap	1 in.
Inside clearance	⅛ in.
Lead	3/16 in.

Wheels

Driving, diameter over tires	69 in.
Driving, thickness of tire	3½ in.
Driving journals, main, diameter and length	11½ in. by 23 in.
Driving journals, others, diameter and length	10½ in. by 14 in.
Engine truck wheels, diameter	33 in.
Engine truck journals, diameter and length	7 in. by 12 in.
Trailing truck wheels, diameter	45 in.
Trailing truck journals, diameter and length	9½ in. by 16 in.

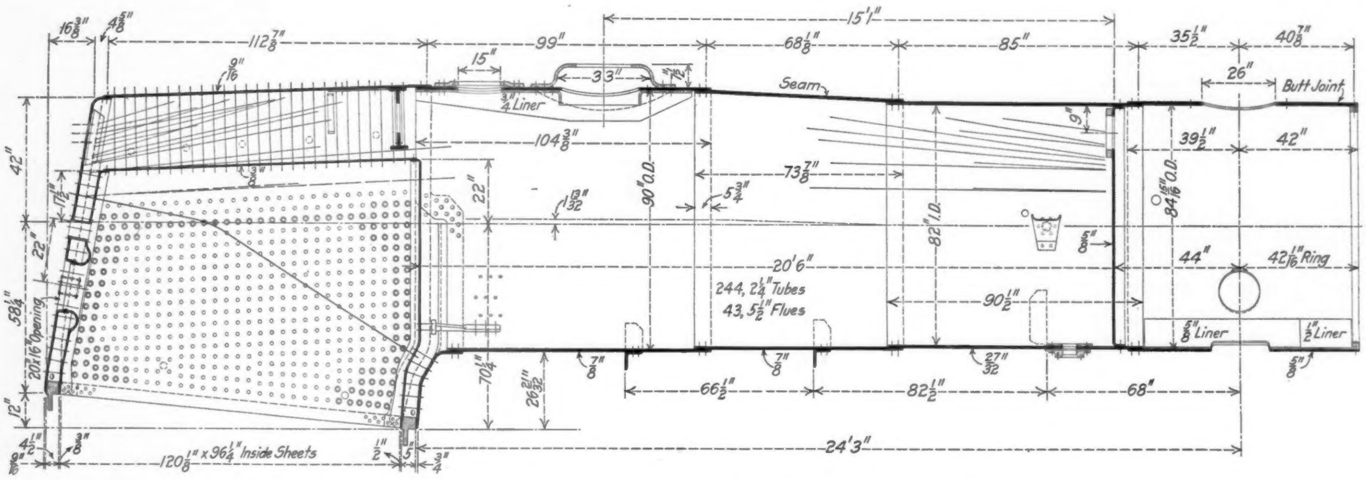
Boiler

Style	Wagon top
Working pressure	185 lb.
Outside diameter of first ring	83 11/16 in.
Firebox, length and width	120⅛ in. by 96¼ in.
Firebox plates, thickness	⅜ in. and ½ in.
Firebox water space	4½ in. back and sides; 5 in. front
Tubes, number and outside diameter	244—2¼ in.
Tubes, material and thickness	Seamless steel, 0.125 in.
Flues, number and diameter	43—5½ in.
Flues, material and thckness	Seamless steel, 0.15 in.
Tubes and flues, length	20 ft. 6 in.
Heating surface, flues	1,263 sq. ft.
Heating surface, tubes	2,933 sq. ft.
Heating surface, firebox	255.4 sq. ft.
Heating surface, arch tubes	27.4 sq. ft.
Heating surface, total	4,478.8 sq. ft.
Superheater heating surface	991.0 sq. ft.
Equivalent heating surface	5,965.3 sq. ft.
Grate area	80.33 sq. ft.
Smoke stack, diameter	20 in.
Smoke stack, height above rail	14 ft. 9½ in.

Tender

Frame	13 in. steel channels
Wheels, diameter and material	36 in. forged steel
Journals, diameter and length	6 in. by 11 in.
Water capacity	9,500 gal.
Coal capacity	14 tons

*Equivalent heating surface = evaporative heating surface + 1.5 times superheater heating surface.



Boiler for the Chesapeake & Ohio Pacific Type Locomotive

DRAFTING DICTIONARY NEEDED.—The language of the engineer can be called the only existing language with any extended use which has no authority to which reference may be made in regard to symbols and conventions. Each drafting office has its own colloquialisms, its own dialect. The crying need of the moment may be said to be the compilation of a dictionary of drafting.—*American Machinist.*

LOCOMOTIVE FRONT ENDS, 1853-1913

Sixty Years' Development on the Baltimore & Ohio; Changes Made from the Time of Wood Burners

BY C. T. ROMMEL

Owing to the many different kinds of coal burned, the drafting of locomotives has always been a very important question on the Baltimore & Ohio. In the eastern territory the coal used is soft and gas from a number of different mines in the Pennsylvania and West Virginia districts, and in the western territory the coal used is generally a gas coal from the Ohio district and a semi-bituminous coal from the Illinois and Indiana districts. It has been the aim to draft locomotives so that when they are transferred from one territory to another the front end arrangement will produce a free steaming engine

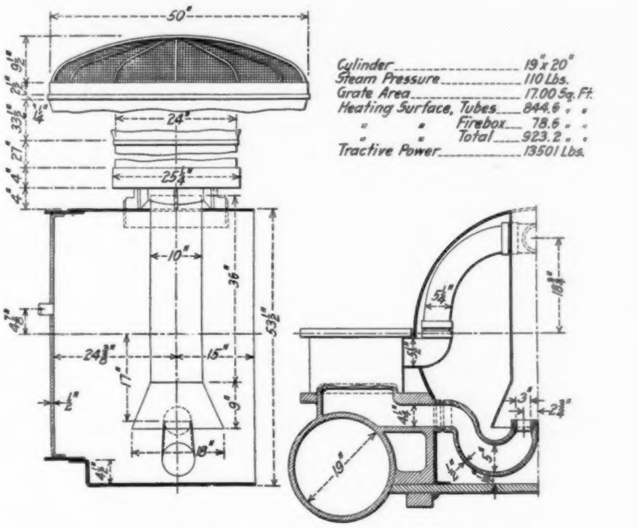


Fig. 1—Front End Arrangement Applied in 1853

with minimum coal consumption and require no change, except perhaps a reduction in the size of the exhaust nozzle.

In view of this, it is interesting to study the different arrangements of front ends that have been used on this road from 1853 to the present.

Fig. 1 shows about the first front end arrangement applied, in 1853. Prior to this time the locomotives in use were of the Grasshopper type, which did not have a smokebox, and therefore did not require any front end arrangement. The arrangement shown in Fig. 1 was used in a Camel 10-wheel engine with the following dimensions:

Cylinders	19 in. by 20 in.
Boiler pressure	110 lb.
Firebox	59 in. by 41½ in.
Grate area	17 sq. ft.
Firebox heating surface	78.6 sq. ft.
Tube heating surface	844.6 sq. ft.
Total heating surface	922.2 sq. ft.
Tractive effort	13,501 lb.
Total weight of locomotive	77,000 lb.

At this time, it will be noted the netting was used in the stack. The steam pipes are along the order of the present day outside steam pipes and the exhaust pipe was separate to each cylinder, giving a very direct path for the escape of the steam from the cylinders. No deflector plate was used and the inside pipe projected into the smokebox below the top of the exhaust nozzle, and this acted, it would seem, in the same manner as the present day deflector plate. The stacks at this time were very long and the smokebox was not circular in form. The bottom part was rectangular, being bolted to the cylinders and the bottom of the frame. These engines were in service east of the Ohio river, the railroad not having been extended beyond that point; the fuel used generally was wood, on account of which the deflector plate was not as necessary as if coal were used.

Fig. 2 shows the arrangement used in 1873 on a Consolidation engine with the following dimensions:

Cylinders	20 in. by 24 in.
Boiler pressure	130 lb.
Grate area	24.97 sq. ft.
Firebox heating surface	1,239.94 sq. ft.
Total heating surface	1,373.47 sq. ft.
Tractive effort	21,216 lb.
Total weight of locomotive	104,100 lb.

With this arrangement the inside steam pipes were used in connection with the half saddle cylinder and the smokebox is circular in form. The netting was located in the top of the stack and no deflector plate was used, although it would appear that the necessity of such a plate was being realized by the arrangement used around the exhaust base, which is rather peculiar.

Fig. 3 shows the arrangement used in 1883 on a ten-wheel type locomotive. These engines had the following dimensions:

Cylinders	19 in. by 24 in.
Boiler pressure	150 lb.
Grate area	23.61 sq. ft.
Firebox heating surface	134.22 sq. ft.
Tube heating surface	1,326.62 sq. ft.
Total heating surface	1,460.84 sq. ft.
Tractive effort	19,724 lb.
Total weight of locomotive	113,200 lb.

This arrangement, it will be seen, shows the adoption of the deflector plate and the netting in the smokebox instead of inside the stack. The exhaust base and nozzle are exceptionally high

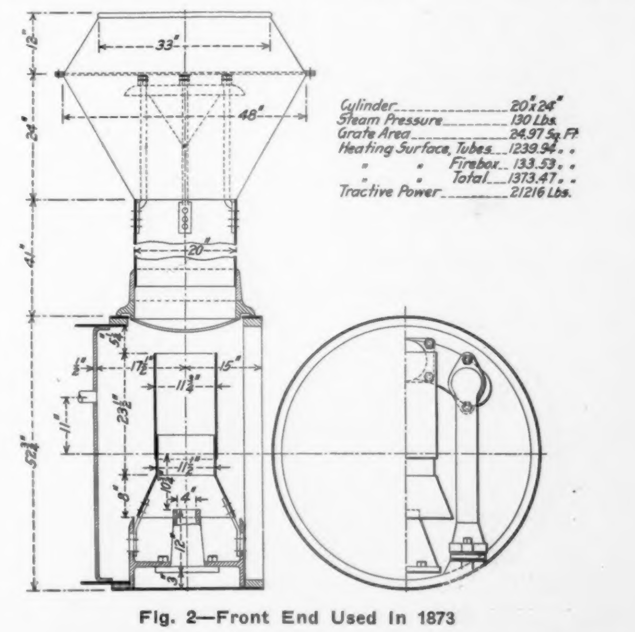


Fig. 2—Front End Used in 1873

and the netting is placed comparatively close to the top of the smokebox, this being done on account of the front end filling up. This arrangement also shows the adoption of the front end extension, which, it will be seen, is bolted to the smokebox proper. The arrangement used for getting out the sparks was the steam ejector, which blew the sparks, which were forced to the bottom of the smokebox by means of a bar inserted through the top handhole to one side of the locomotive. It would seem that the use of the deflector plate was not given

very serious attention, as this deflector plate did not fit tightly against the sides of the smokebox, having a 3-in. opening.

Fig. 4 illustrates the arrangement applied to a six-wheel switching locomotive at about the same time. It had dimensions as follows:

Cylinders	19 in. by 24 in.
Boiler pressure	150 lb.
Grate area	17.25 sq. ft.
Firebox heating surface	108.77 sq. ft.
Tube heating surface	1,249.74 sq. ft.
Total heating surface	1,358.51 sq. ft.
Tractive effort	22,093 lb.
Total weight of locomotive	97,700 lb.

This arrangement is similar to that shown in Fig. 3, except that the deflector plate has been made different at the top and the inside stack extension is placed closer to the center line of the boiler. The smokebox extension is riveted to the junction ring instead of being bolted in place. The means provided for getting the sparks out of the front end has been changed to a spark drop in the bottom.

It was realized with the arrangement shown in Fig. 3, where the deflector did not fit tightly against the smokebox, that the draft obtained was not satisfactory, and on this arrangement the deflector plate is brought tight against the sides; but the question whether or not this would result in the satisfactory burning of the fire not being definitely decided, the deflector plate was perforated with ½ in. holes at 1¼ in. centers. Also the necessity of having some means of getting to the top of the netting

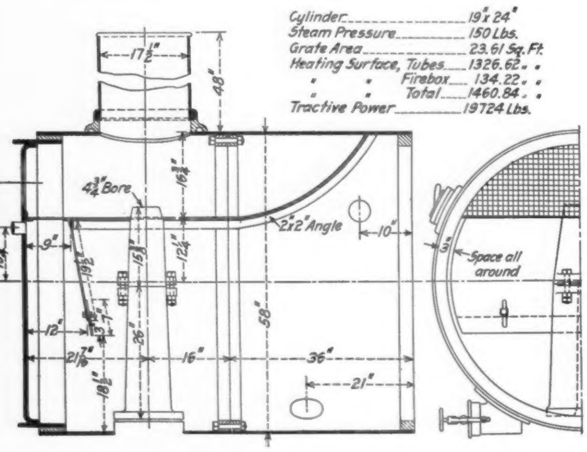


Fig. 3—Front End Used on a Ten-wheel Locomotive in 1883

was realized and the hinged trap was used. The height of the exhaust base and nozzle was considerably decreased, which, according to the records, resulted in a freer steaming locomotive, although the size of the exhaust nozzle with the arrangement shown in Fig. 4 is smaller than that shown in Fig. 3, the cylinders and boiler pressure being the same and the heating surface less in the latter arrangement.

In Fig. 3 it will be noticed that the length of the smokebox extension is 36 in., while in Fig. 4 it is 18 in.

Fig. 5 shows the arrangement used about 1893 on a Consolidation locomotive of the following dimensions:

Cylinders	21 in. by 26 in.
Boiler pressure	165 lb.
Grate area	24.04 sq. ft.
Firebox heating surface	150.37 sq. ft.
Tube heating surface	1,839.06 sq. ft.
Total heating surface	1,989.43 sq. ft.
Tractive effort	31,188 lb.
Total weight of locomotive	120,800 lb.

It will be noted that this arrangement was applied to a smokebox 65 in. in diameter, which is 9 in. larger than that shown in Fig. 4. The length of the exhaust nozzle has been increased while the nozzle has been reduced; the relation of the table netting to the center line of the boiler is practically the same and a perforated basket is used between the table netting and the top of the exhaust nozzle. The deflector plate has been perforated to a greater extent in rather a novel manner and the length of the smokebox extension has been increased from 18 in. to 30 in. The stack extension has been fastened tightly to the stack.

It probably will have been noticed that the boiler pressure has increased from 110 lb. in 1853 to 160 lb. in 1893, and the arrangement shown in Fig. 6 was used in 1903 on a class of locomotives which had the following dimensions and a boiler pressure of 205 lb.:

Cylinders	22 in. by 28 in.
Boiler pressure	205 lb.
Grate area	48.06 sq. ft.
Firebox heating surface	184.32 sq. ft.
Tube heating surface	2,662.92 sq. ft.
Total heating surface	2,847.24 sq. ft.
Tractive effort	42,168 lb.
Total weight of locomotive	193,500 lb.

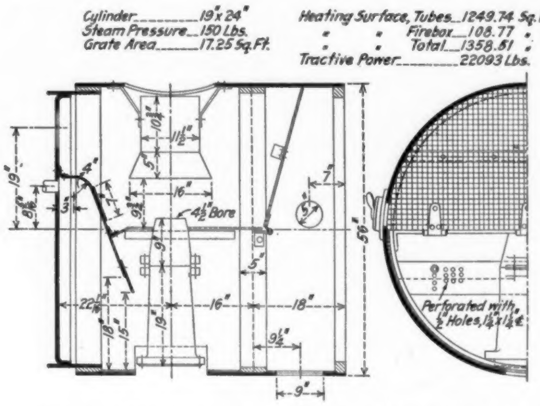


Fig. 4—Front End Formerly Used on a Six-wheel Switcher

It will also be noted that this engine was the first step towards the wide firebox. This front end arrangement was the diamond basket shape, very popular at that time. The exhaust base was reduced in length and the length of the smokebox extension was also reduced. The deflector plate was still perforated.

This arrangement resulted in a very free steaming engine, but the front filled up easily, which resulted in the basket burning out, causing considerable trouble. To overcome this, the arrangement shown in Fig. 7 was adopted after experiment. This front end was applied to a Consolidation locomotive having:

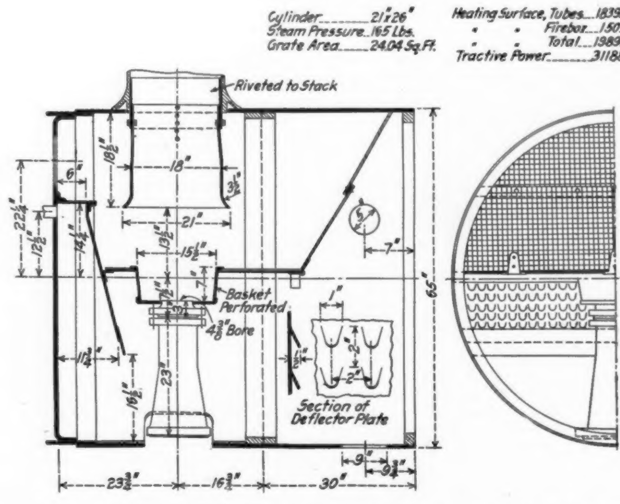


Fig. 5—Front End for a Consolidation Locomotive in 1893

Cylinders	22 in. by 30 in.
Boiler pressure	205 lb.
Grate area	57.05 sq. ft.
Firebox heating surface	179.3 sq. ft.
Tube heating surface	2,594.78 sq. ft.
Total heating surface	2,774.08 sq. ft.
Tractive effort	42,168 lb.
Total weight of locomotive	220,370 lb.

This arrangement marks the first step in a radical departure from the arrangements previously described. The deflector plate is not perforated. The tapered stack is used with inside extension. The mouth of the inside extension is of a much larger diameter and is belled. The table netting has been lowered below the center line of the boiler. The combined length of the exhaust base and nozzle has been materially reduced and a basket made of netting is used between the table netting

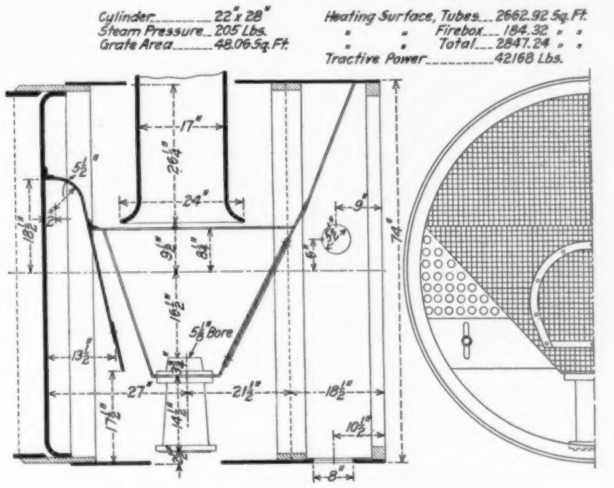


Fig. 6—A Front End Design of 1903

and the exhaust nozzle. The practice of riveting a smokebox extension to a junction ring has been discontinued, although the distance from the center of the exhaust to the front of the smokebox is practically the same. The amount of taper for the stack and the choke in the inside stack extension was obtained by means of draft gages with adjustable nipples which were located 12 in. apart, as shown in the illustration. These nipples were screwed in or out until the same amount of draft

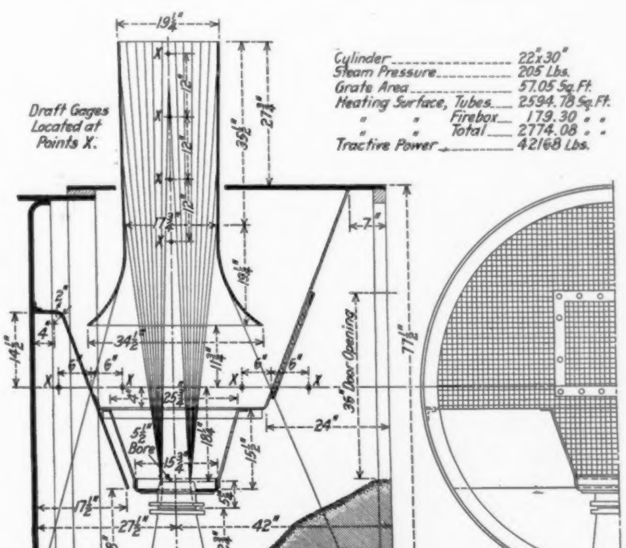


Fig. 7—Front End Designed to Overcome Difficulties Encountered in Using the Design Shown in Fig. 6

was obtained with all four gages, and by this means the necessary dimensions were obtained. The stack liner was made to these dimensions and applied, and after the application of the liner, the draft gages at the points marked *X* at top and bottom of stack, front and back of deflector plate and front and back of netting, all showed a uniform draft, a condition seldom obtained.

This front end was practically self-cleaning. After sealing the front end and running the engine for two weeks only the amount of sparks shown in the illustration were found in the front.

The writer has personally seen a locomotive, fitted with this arrangement, work in full gear for 27 minutes, and during this time the locomotive popped against the injector six times.

Comparing this design with the best arrangement from the Master Mechanics' tests in 1906, while it is not of the same diameter, it nearly checks with the recommended practice, with the exception of the amount of choke and taper. According to the recommendations, the choke in the stack should be .21 diameter plus .16 of the distance from the center line of the boiler to the top of the exhaust nozzle.[*] Using this formula, with this arrangement, the diameter of the choke would be 19.1 in., while in the illustration it is shown as 17.75 in. The taper of the stack recommended is 2 in. to the foot, while that shown in the illustration is ¾ in. to the foot. The distance from the center of the boiler to the top of the exhaust nozzle is recommended to be as great as practicable. In the arrangement shown it is 18¼ in. The height of the stack is also recommended to be as great as practicable, and in this case it is 27¾ in., being governed by clearance limitations. The

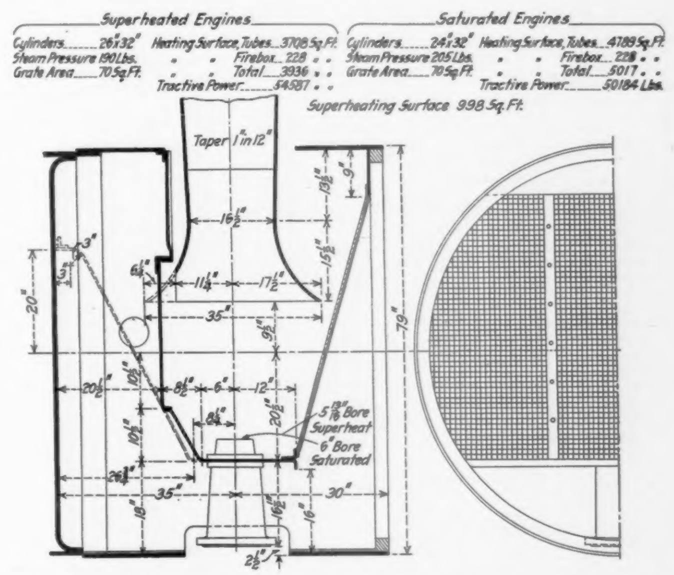


Fig. 8—Self-cleaning Front End for Saturated or Superheated Steam Locomotives

distance from the top of the smokebox to the top of the stack extension is recommended as .32 diameter, which would make this dimension 24.8 in., while the actual figure is 26.25 in. The distance from the choke to the bottom of the stack extension, according to the recommendations, is .22 diameter or 17.05 in., while in the arrangement shown it is 19¼ in. The length of the smokebox is recommended as .9 diameter, which would mean 69.7 in., while the actual figure is 69.5 in.

The writer believes that the recommendations made by the Master Mechanics' Committee are open to some criticism as regards the diameter of the choke and the amount of taper in the stack, when it is considered that when the Master Mechanics' tests were made, the fuel used was oil and no netting was used in the smokebox, which means that actual conditions in service were not obtained. When netting is used a greater amount of draft is required to produce a certain amount of draft in the ashpan than when the netting is not used, and it is on this account that the writer believes that the amount of taper as recommended by the Master Mechanics' Committee is too large.

The front end illustrated in Fig. 7 was designed from results obtained in service tests. This design is somewhat similar to

that developed by some of the western railroads burning Lignite coal, and the results obtained with its use were very gratifying.

Fig. 8 shows the design illustrated in Fig. 7 developed into a self-cleaning front end for both superheated and saturated steam engines, and, in the mind of the writer, represents the best arrangement of front end now in use. The tapered stack and inside stack extension with large bell mouth is retained. The exhaust base has been increased in length a sufficient amount so that the table plate will be the proper distance above the bottom of the smokebox. The distance from the center of the exhaust to the center of the smokebox has been reduced in length so that there is just enough room in front of the cylinder saddle to get a sling around the smokebox to lift the engine off the wheels with a crane.

Another feature of this design is that the table is placed between the exhaust nozzle and the base, so that any change in the exhaust nozzle will not necessitate the removal of the table plate. This front end is in use on Mikado type locomotives of the dimensions shown in the illustration, the total weight of the superheater locomotive being 284,500 lb. and the saturated steam locomotive 276,050 lb. It gives very good results under all fuel conditions and is absolutely self-cleaning.

During the time of the development of the front end arrangement to the self-cleaning type, a standard nozzle pattern was adopted, the bore of which is governed by the size of the locomotive and the kind of fuel burned, and this one pattern answers for all of the heavier engines built since 1890.

While the arrangement shown in Fig. 8 is applicable to the heavier power, all of the front end arrangements are designed with the same relative dimensions and the results obtained on all classes of locomotives equipped with this arrangement have been gratifying.

The question very often arises as to the efficiency of different shaped orifices in the exhaust nozzle and Fig. 9 illustrates the diverging angles of steam passing through the nozzles shown, which may be of some assistance in this respect. The path of escaping steam was obtained by actual measurements with a constant back pressure, and while the area of the nozzles is very much smaller than that used in practice, the path of the escaping steam should be the same regardless of the diameter.

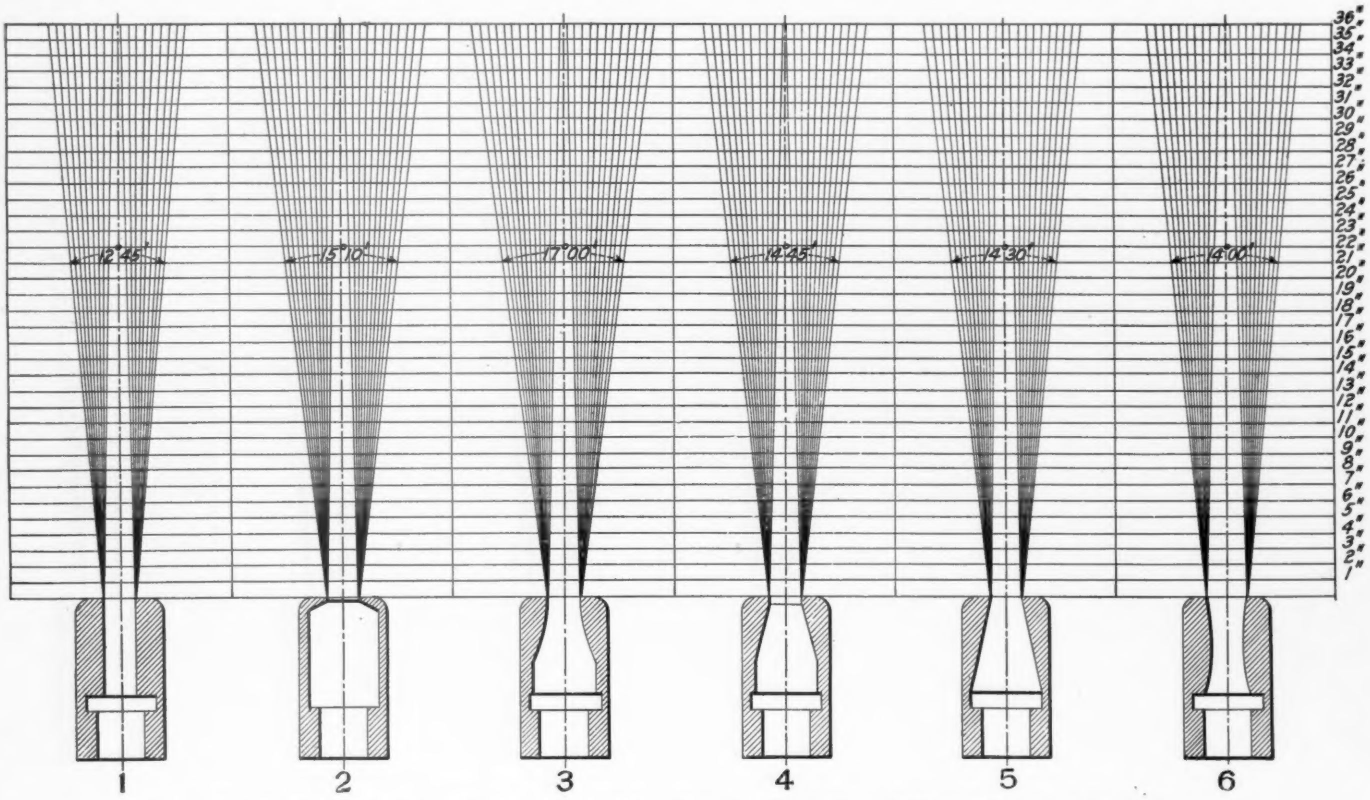


Fig. 9—Tests to Determine the Path of the Exhaust Steam from Different Types of Nozzles

DIVIDING THE CIRCUMFERENCE OF A CIRCLE

BY WM. H. WOLFGANG

A table for dividing the circumference of a circle into any number of equal parts, by means of chords, is given below. In the formula $C = D \times X$, C is the length of the required chord in inches, D is the diameter of circle in inches, X is a factor depending upon N, and N is the number of equal parts into which the circumference is to be divided.

In using the table, find the desired value of N and substitute in the rule the value of X shown opposite in the table. The value of C thus found will be the length of chord required to divide the circumference of the circle into the desired number of equal parts.

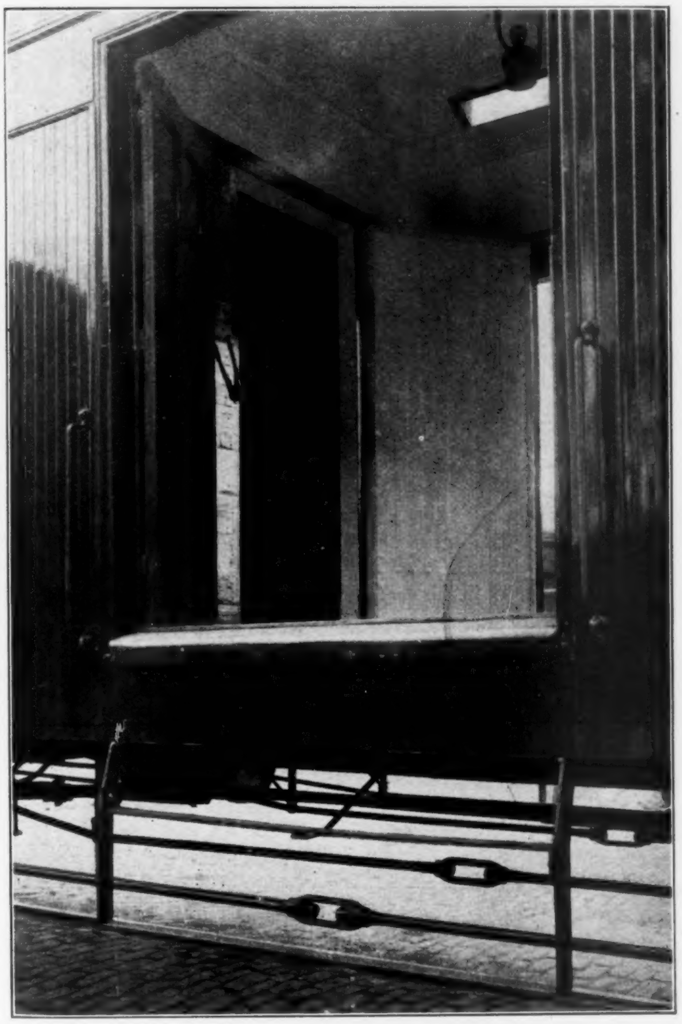
Factors for Use in Determining Length of Equal Chords

N	X	N	X	N	X	N	X
1....	......	26....	.12054	51....	.061560	76....	.041325
2....	......	27....	.11609	52....	.060379	77....	.040788
3....	.86603	28....	.11197	53....	.059240	78....	.040267
4....	.70711	29....	.10812	54....	.058145	79....	.039757
5....	.58779	30....	.10453	55....	.057090	80....	.039260
6....	.50000	31....	.10117	56....	.056071	81....	.038775
7....	.43388	32....	.098018	57....	.055089	82....	.038303
8....	.38268	33....	.095056	58....	.054139	83....	.037841
9....	.34202	34....	.092269	59....	.053222	84....	.037391
10....	.30902	35....	.089640	60....	.052336	85....	.036955
11....	.28173	36....	.087156	61....	.051478	86....	.036522
12....	.25882	37....	.084804	62....	.050649	87....	.036103
13....	.23932	38....	.082580	63....	.049845	88....	.035692
14....	.22252	39....	.080466	64....	.049068	89....	.035391
15....	.20791	40....	.078460	65....	.048312	90....	.034899
16....	.19509	41....	.076549	66....	.047582	91....	.034516
17....	.18375	42....	.074731	67....	.046872	92....	.034141
18....	.17365	43....	.072995	68....	.046184	93....	.033774
19....	.16460	44....	.071339	69....	.045515	94....	.033415
20....	.15643	45....	.069756	70....	.044865	95....	.033064
21....	.14904	46....	.068243	71....	.044232	96....	.032719
22....	.14232	47....	.066793	72....	.043619	97....	.032381
23....	.13617	48....	.065401	73....	.043022	98....	.032051
24....	.13053	49....	.064073	74....	.042441	99....	.031728
25....	.12533	50....	.062791	75....	.041875	100....	.031411

CAR DEPARTMENT

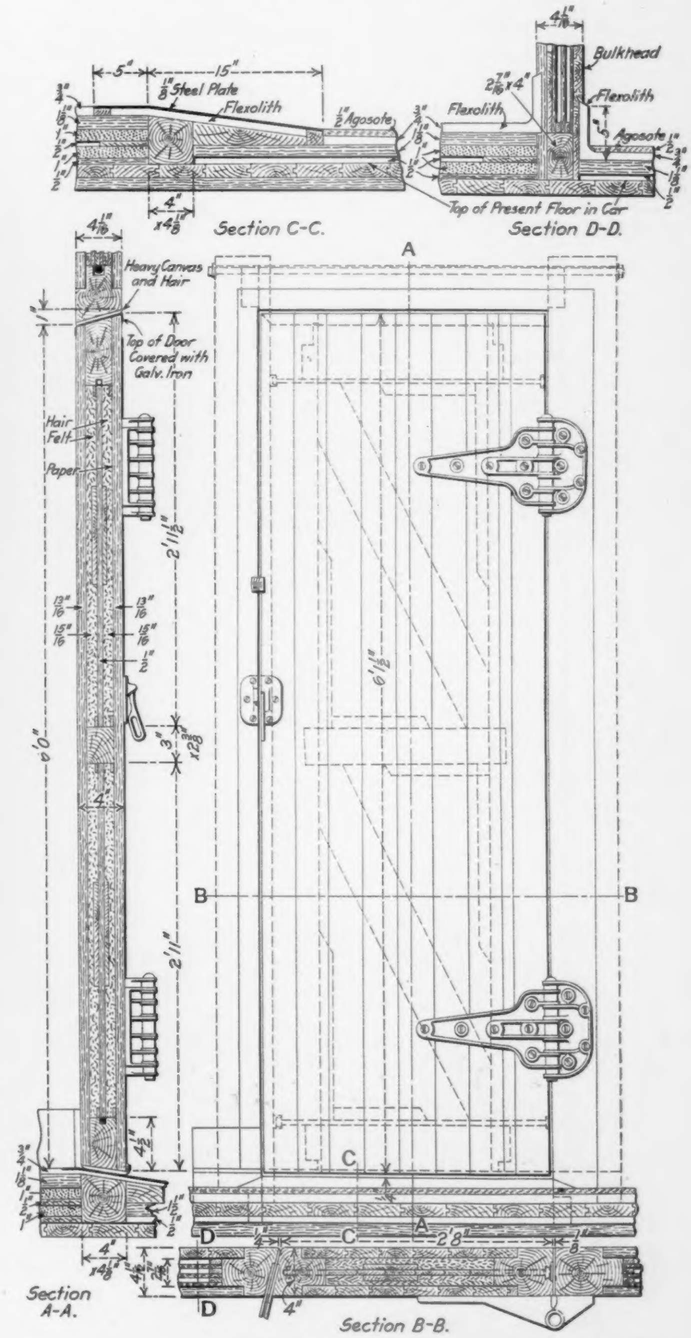
BALTIMORE & OHIO MILK REFRIGERATOR CAR

The Baltimore & Ohio has recently placed four dairy refrigerator cars in milk service between points in Ohio and the Pittsburgh market, in the construction of which special attention has been given to proper sanitation. The new cars are remodeled from wooden postal cars, the work being done at the Mt. Clare shops of the Baltimore & Ohio, according to specifications approved by the United States Department of Agriculture. They will insure the arrival in Pittsburgh of milk from Chicago Junction, Painesville and intermediate points at a temperature of 45 deg. after a run of five hours. It is also claimed for the cars that they will retain a uniform temperature for 48 hours with one icing when the temperature outside the car is as high as 90 deg.



Side Doors and Bulkhead of Baltimore & Ohio Milk Refrigerator Car

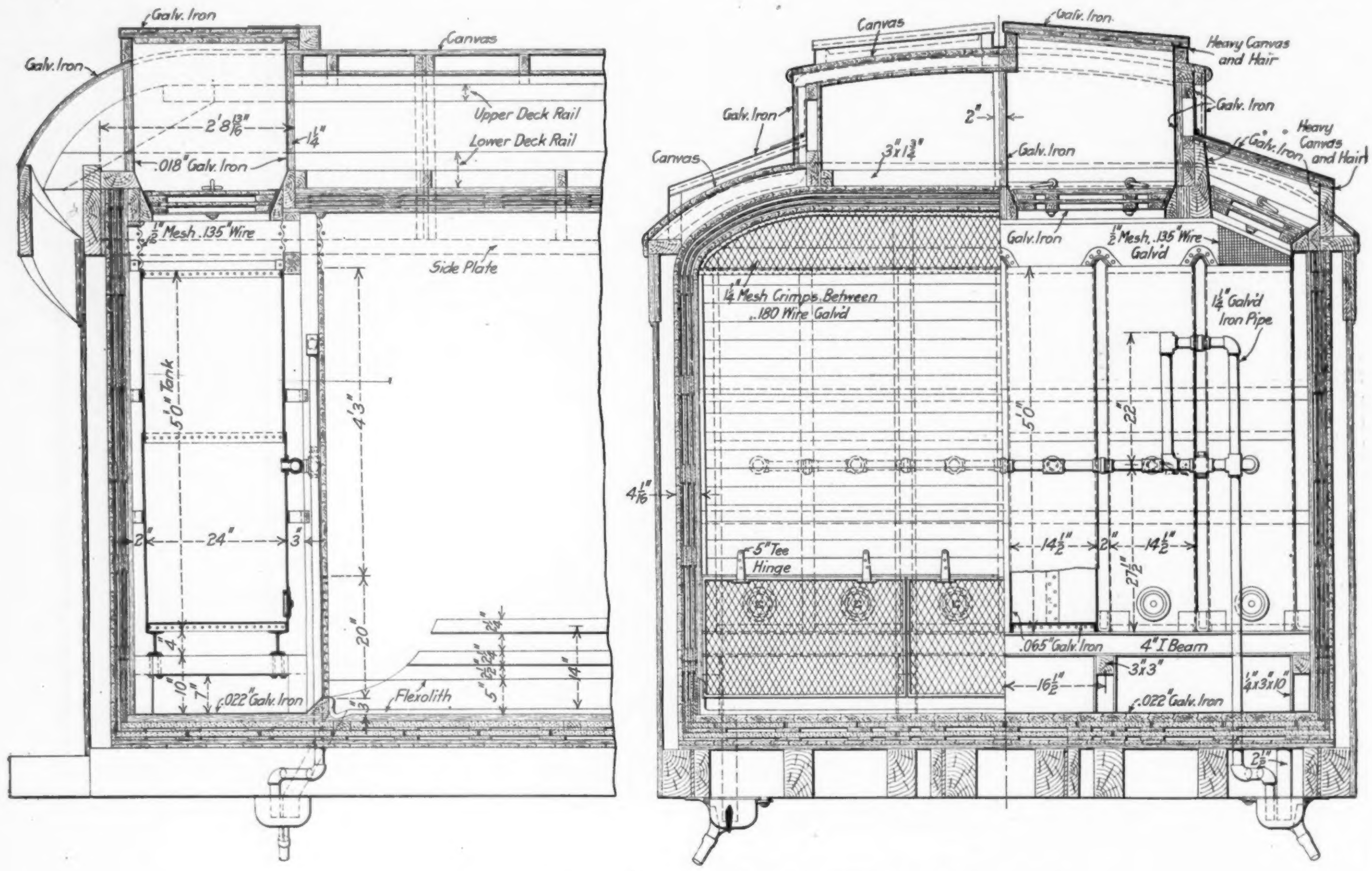
These cars have a length of 60 ft. over the body and are carried on six-wheel passenger trucks, the external appearance harmonizing throughout with other passenger equipment. Each car has two ice bunkers 2 ft. 5 in. in width, extending across the ends and is divided into two refrigerator compartments, each 22 ft. 6 7/16 in. long, and having a capacity of 130 ten-gallon milk cans, by bulkheads across the car on either side of the center doorway. Each ice bunker contains six brine tanks, which are filled with ice and salt through hatches in the roof and are arranged to drain automatically when the brine reaches about three-quarters the height of the tank. A greater depth of brine may be retained if desired, by closing a three-way cock accessible through a hole in the bunker bulkhead. Handholes are provided near the bottom of the tanks through which they may be drained. The bulkhead has an opening in both top and bottom covered with heavy wire mesh, these openings furnishing a means of circulation to and from the refrigerator compartment; and the tanks are so placed that both sides are accessible to circulation, thus providing a



Details of Bulkhead Door

maximum radiating surface. The siphon which fixes the depth of brine in the tanks is shown in one of the engravings.

In remodeling these cars practically no change was made in the original construction, the insulation and interior finish of the refrigerator cars being applied above the original finish of the postal cars. The floor insulation consists of two layers of 1 in. cork board and a 1⅛ in. top floor, above which is applied a layer of ¾ in. Flexolith, ½ in. air spaces being provided between layers of the cork board and the sub-flooring. The Flexolith floor is flashed up to a height of 5 in. all around with fillets in the corners. Across the car at the bulkhead in front of the brine tanks a gutter with adequate drains is formed in the Flexolith to give proper drainage. The floor may thus be flushed whenever the cars are cleaned and left in a thoroughly sanitary condition. In the center



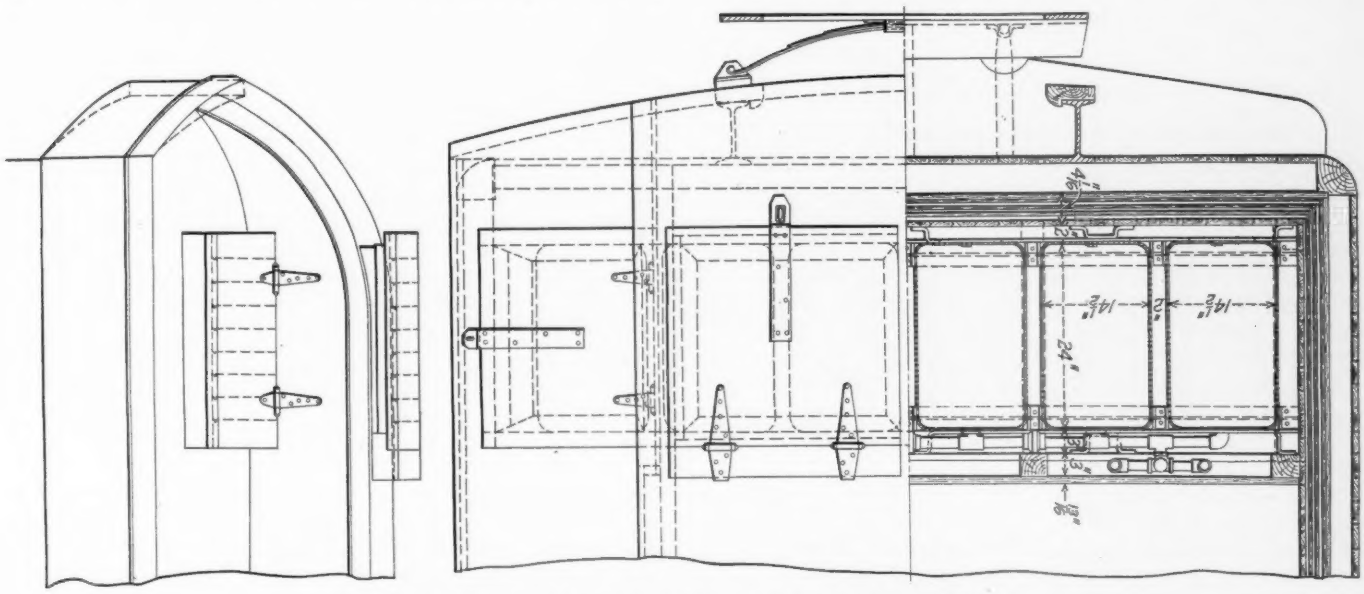
Sections Through the End of the Car Showing Arrangement of Brine Tanks

Refrigerator Car for Milk Traffic on the Baltimore & Ohio, Rebuilt from a Postal Car

compartment opposite the side doors Agasote is applied over the Flexolith to take care of the excessive wear due to the handling of milk cans. This covering may be easily removed.

The sides, ends and ceiling are insulated with three courses of Phoenix car insulation, both sides of each course being covered with paper stitched through, and air spaces being provided between the layers. The whole is covered with 13/16 in. yellow pine sheathing over which a coat of white enamel paint is applied. Along the sides near the bottom are applied two fending strips to prevent the milk cans from scarring the inside finish of the side walls. The clerestory is ceiled off from the body of the car and the ventilators in the upper deck have been closed up, thus forming a dead air space above the refrigerator sections where radiation is greatest. The hatches are provided with plugs at the bottom, as well as covers at the roof, which provides against undue radiation from the bunkers.

The cross bulkheads at the center of the car are 4 1/16 in. thick and are provided with refrigerator type doors which effectively seal the refrigerator compartments from the center section. These doors swing back against the bulkhead when loading or unloading the car. The side doors are in two parts hinged to swing inward, having glass panels in the top, which with glass sash in the upper deck, gives ample light for the center section.



Half-Sectional Plan and Elevation Showing Brine Tanks and Hatches

The Department of Agriculture is showing much interest in this equipment. Daily records of the temperature of the cars are being taken, together with data as to the quantity of ice consumed and other information bearing on dairy product transportation.

INTERCHANGE OF CARS*

BY H. BOUTET
Chief Interchange Inspector, Cincinnati, Ohio

It is of very little use to receive a car of freight at one point, haul it over the line and then have it refused by some other line, as the railroad has not completed its service until it has delivered the car to a connecting line or to its destination. While a great deal has been accomplished toward improvement in the getting of cars through terminals, much is yet to be accomplished. A great deal more could be done by seeing, when cars are empty, that all of them are put in such a condition that they are safe to haul the commodities they are built to carry, or at least such commodities as originate on your line, to any destination within reason.

Make it the duty of some person to see that your inspectors do not allow any cars to get out on your line that are not in good condition, and see that all agents along your line have a good general knowledge of a car and the M. C. B. rules, more especially the loading rules. This will save a great many transfer orders being given against your line.

The M. C. B. rules have as many interpretations as the father has excuses for taking his hopefuls to the circus, each person will claim that his interpretation is the only correct one. I have no doubt that some of you will say this is wrong, that there can be only one interpretation to any one rule.

Unfortunately there never have been any rules or laws so plain but what somebody can and will misunderstand them or see something in them that someone else does not see. Sometimes this is an honest difference of opinion and sometimes it seems that it is a notion taken with the view to see how different they can be from other people.

Take a case out on your line, where there are two interpretors, one inspector working for your line and one representing the other line. The inspectors have gotten into a disagreement regarding the condition of a car. The car foreman will go to that point and ask his inspector what the trouble is, and the inspector will tell his foreman that the car has three broken sills. The foreman will examine the car and find three of the sills with a crack from ½ in. to 1 in. near the transom and he will tell his inspector that these are not bad enough for repairs. His inspector's answer to this will be that he has been compelled to card for such defects as these all the time since the present rules were in force, and the other inspector's foreman upholds him in setting out such cars and will not accept the cars without a defect card. The foreman will take the side of his inspector and tell his master mechanic that the car should be carded and that the defects are of such a nature that they have been carded for all the time. Finally the case is settled by the other fellow carding the car, after it has been delayed some three or four weeks. This, of course, makes the inspector of the delivering line angry and causes him to become more technical in his inspection to enable him to get even with the other line, while the inspector who gains his point, sticks a feather in his hat and says, "I told you so." This delay to cars is the worst enemy the transportation department has to fight.

Some people will tell you that, according to M. C. B. rules, it is necessary for the delivering line to inspect and set out all cars for repairs or transfer and card for delivering line defects that are safe to run before the cars are delivered. Others will tell you that you must set all of your cars for interchange on

*From a paper read before the Southern & Southwestern Railway Club, Atlanta, Ga., September 19, 1914.

a certain or delivery track, when the cars will be inspected by the receiving line and after inspection the delivering line must come back and take out all of the cars for repair or transfer. Others will tell you that what is known as Twentieth Century Inspection is M. C. B. rules.

Now let us see if we cannot get at a common understanding of this particular matter. The preface of the M. C. B. rules says in substance, that car owners are responsible for ordinary wear and tear in fair service; railroads handling the cars are responsible for damage done by unfair usage, derailment, accident, etc. The rules then go on to define a large number of defects in accordance with the preface.

The M. C. B. rules are given us as a basis on which to work. The writer takes the stand that it does not matter where a car is inspected; whether in the delivering or receiving line's yard. as may be agreed upon by the roads interested; sometimes local conditions determine this question so there can be no hard and fast rule about it. It is understood that the delivering line is held responsible for any damage that may have been caused to cars by unfair usage, derailment or accident, or any missing material that cannot be charged to the owners of the cars in interchange.

Let us take the situation at Cincinnati. The majority of interchange is made through switching lines or through two or three yards by the delivering line, the distance between some of the delivering line and receiving line yards being 26 miles. There are several methods by which inspection and interchange could be made, all of which the writer claims are within the scope of the M. C. B. rules.

First.—It could be made by the receiving lines putting their inspectors in the delivering line's yard and after the cars are side carded, inspecting and marking out such cars that they want repaired, transferred or carded. Cars passing the inspectors as O. K. for service could be switched out and delivered to the receiving line.

Second.—Cars could be inspected by the delivering line's inspectors and cars that they think should be repaired or transferred, for defects that they think should be cared for, should be carded and delivered to the receiving line.

Third.—The inspectors could be placed under the chief interchange inspector, and cars inspected in the delivering line yard; cars that are required to be set out could be marked out, those requiring repairs could be repaired, those requiring transfer could be transferred and those requiring cards could be carded.

Fourth.—Cars could be given a safety inspection in the delivering line yard by the delivering line's inspectors to see that they are safe to go to the repair or transfer track of the receiving line. When they are delivered in the receiving line's yard they could be inspected by the receiving line's inspectors, cars that require repairs or transfer could be set out for the necessary work and the cars requiring cards could be carded.

Now let us see the advantages and disadvantages of these different plans.

First system.—It would be necessary for the lines to have twice as many inspectors, or more than would be required under the other plans, as no road would agree to have a car inspected in a foreign yard and then switched and handled by a foreign road, without its again being inspected when received in their yard. You would have the advantage of having all bad order cars set out in the delivering line yard, consequently, you would only receive good cars or only such bad cars as were made such after inspection.

Again, it should be taken into account that no inspector would take any responsibility if he was placed in the delivering line yard; if there was any question at all he would set the car out. His foreman would not take any great exceptions to this, for if the delivering line foreman came to him and told him that his inspectors were too close, the only answer would be that they were "not any closer than your inspectors, for your inspectors are doing the same in my yard, and when you have your inspectors set out only such cars as should be set out, I will have my inspectors do the same." The consequence would be, if you did not have a chief interchange inspector or assistants located in each yard both day and night, your line would be blocked in 24 hours with cars that the receiving line's inspectors had set out for repairs or transfer, when in fact a great number of them should not have been set out. You have delayed freight, caused extra switching and consequently created additional expense, and also created a feeling with the shipper that you had not attempted to give him the proper service.

Second system.—It has never been found that the delivering line will inspect and card all cars that the receiving line wants carded or set out all cars that the receiving line thinks should be set out, either for transfer or repairs, nor will they card all cars for defects that the receiving line wants carded. This system has been tried at every large interchange point in the country and has never proved satisfactory. You have all of the work to do over, as you are not satisfied that the other fellow has given you all that you should have had and as you have to answer for the safety of equipment going over your line, you want to know positively that it meets all requirements and therefore will have your own men inspect the cars as they come to you.

Third system.—This does not always prove satisfactory as the men you employ are under another man's jurisdiction and supervision and you are not always able to get the desired results, as the instructions that you require for your particular line are not always carried out in the manner you desire, the instructions issued to inspectors being of a general nature and about on a par with what all the roads require. In this way you have your work to do over for about the same reasons as given in the reference to the second system.

Fourth system.—This has some disadvantages, but in the writer's opinion has a great many advantages over the other systems. You have the disadvantage of bad order cars coming to your line either for repairs or transfer, which is offset by the cars in the same condition going from your line to the other line.

The advantages are numerous. You have the advantage of having your own inspectors in your own yard directly under your own supervision and you can require them to use their judgment, according to the instructions given by you in the marking out of cars for repairs or transfer.

Every car that they mark out is brought to the immediate attention of the car foreman and for every car that they mark out that should not be marked out, you have the remedy which you can apply directly. The consequence is that they do not mark any cars out that you do not want marked out and in this manner save a lot of switching and confusion. Again, if a car should have a cotter key out or require other slight repairs, which the inspectors could make in less time than they could mark the cars out, you will have them make these repairs; but if the car was in the other person's yard the inspector would claim that he was sent there to inspect cars, not to repair them.

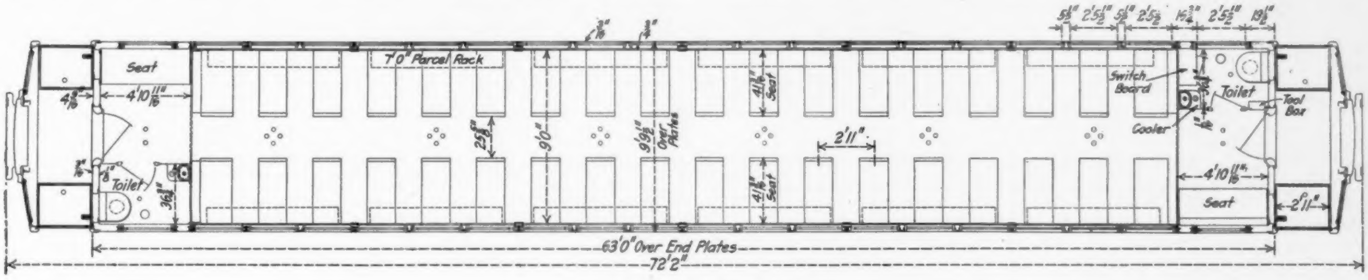
The fourth system, as described above, is the way that the interchange is done at Cincinnati, and it is believed to have accomplished the best results, keeping the cars moving with a minimum loss of time and not setting cars out unnecessarily, only setting out such cars that are liable to cause damage. The inspectors in the receiving line yard card for all defects on cars that they do not wish set out.

The assistant chief interchange inspector visits each yard each day and cards all cars set out for repairs, combinations and heavy defects. This method of carding has been in effect a little over two years and while there have been some cases where the inspectors have been wrong, where we have been compelled to give rebuttal cards to straighten the trouble, I have the first case to find where the inspector wilfully misused the cards. There is no set back of cars for bad condition except on instructions of the chief interchange inspector, consequently the number of set back cars is a minimum.

Jersey Central Steel Passenger Cars

Coach and Combination Car, 63 Ft. Long Over End Plates and Carried on Four Wheel Trucks

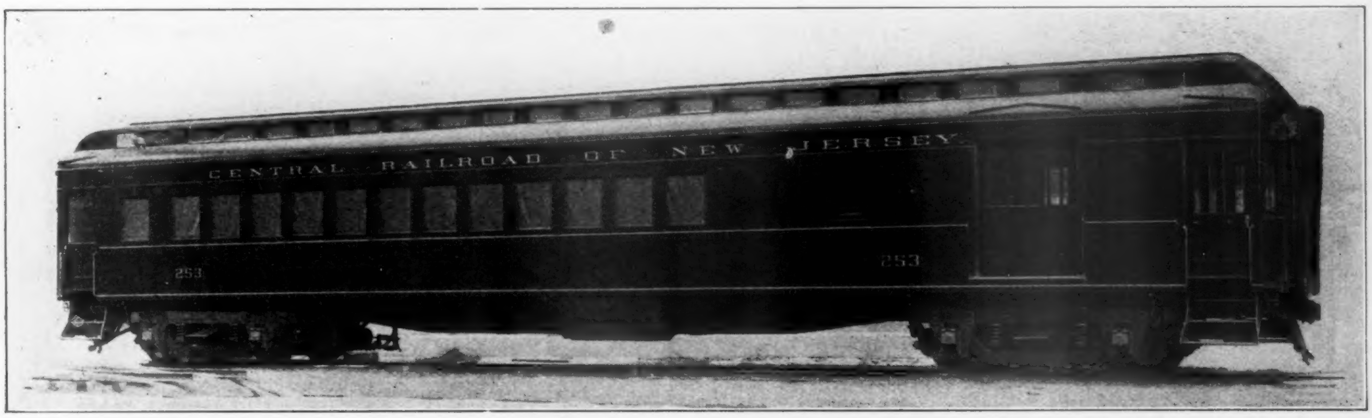
The Central Railroad of New Jersey has recently placed in service 67 steel coaches and nine steel combination cars built by the Harlan & Hollingsworth Corporation, Wilmington, Del. These cars are 63 ft. long over the body end plates and 72 ft. 2 in. long over the buffers, the truck centers being 49 ft. apart. The coaches have a seating capacity of 78, while the combination cars will seat 51 persons, and have a baggage room 22 ft. $4\frac{1}{2}$ in. long. The framing of both types of car is similar, and the description which follows will be confined to the coach.



Floor Plan of the Coach

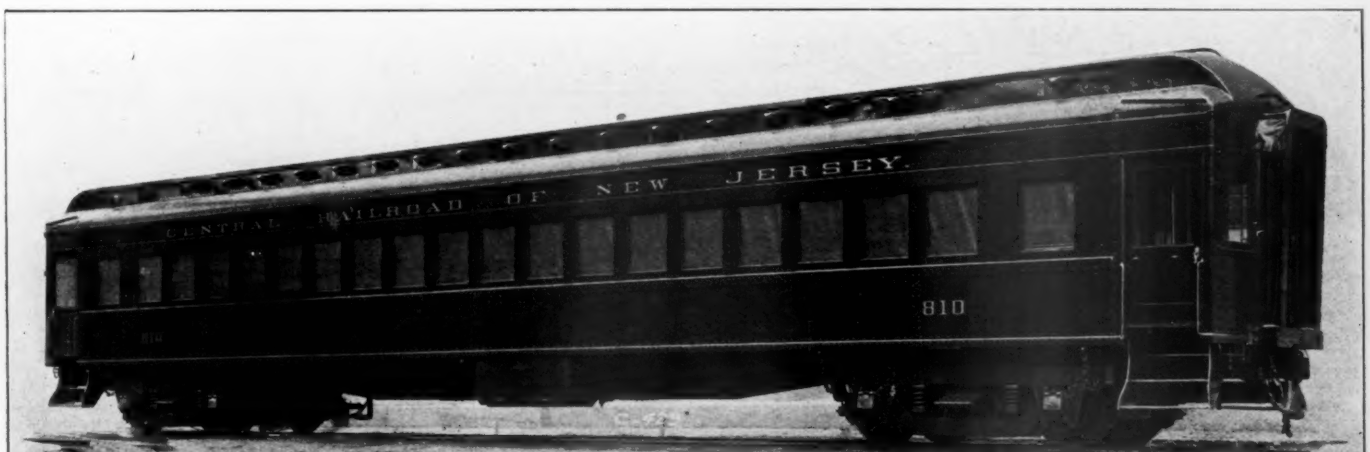
UNDERFRAME

The principal member of the underframe is the center sill, which is of the built up fishbelly type, and extends through between the platform end sills. The web plates are spaced 18 in. apart and are 2 ft. 4 in. deep for a distance of 10 ft. 8 in. on either side of the center line of the car, tapering to $18\frac{1}{8}$ in. at a point 6 ft. 4 in. further on. There are $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by 5/16 in. angles reinforcing the web plate both inside and outside at the top and bottom, in addition to which there is a 29 in. by $\frac{1}{2}$ in. top cover plate 59 ft. $7\frac{3}{8}$ in. long. The side sills are 6 in. by $3\frac{1}{2}$ in. by 7/16 in. angles.

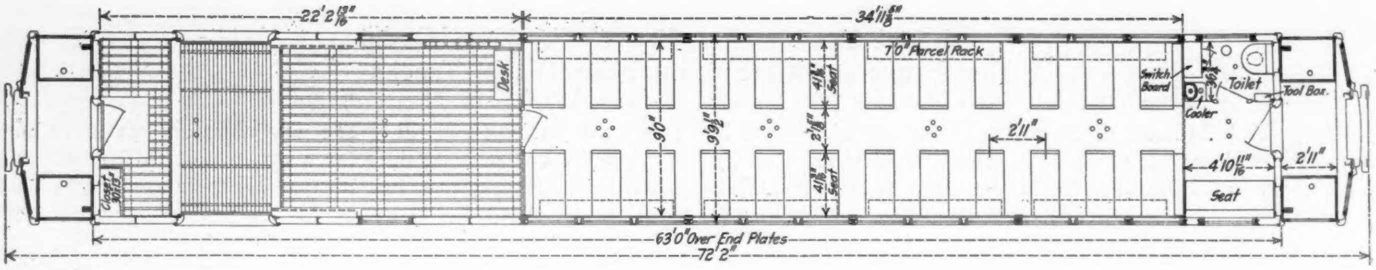


Steel Combination Car for the Central of New Jersey

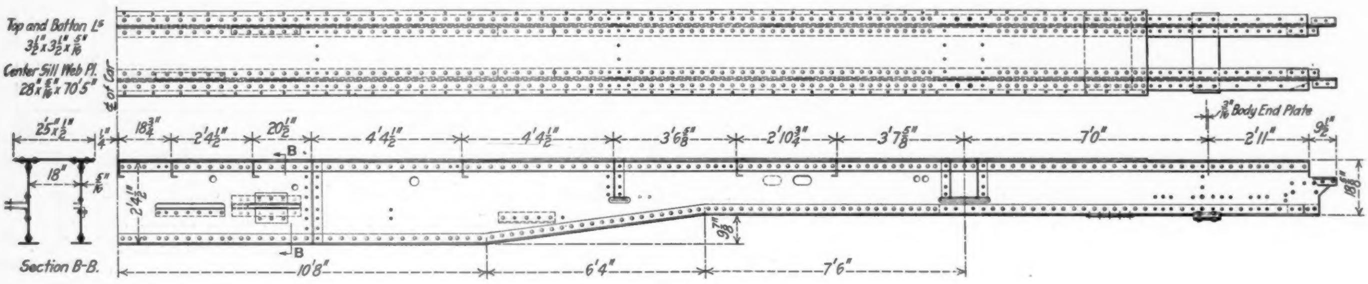
The body bolsters are built up of 5/16 in. pressed diaphragm, with a $\frac{1}{2}$ in. by 20 in. top cover plate extending the width of the car, and a $\frac{3}{4}$ in. by $16\frac{1}{2}$ in. bottom cover or tie plate, 9 ft. $10\frac{1}{2}$ in. long. There are two crossbearers placed 5 ft. 8 in. from the center line of the car, and two intermediate crossbearers



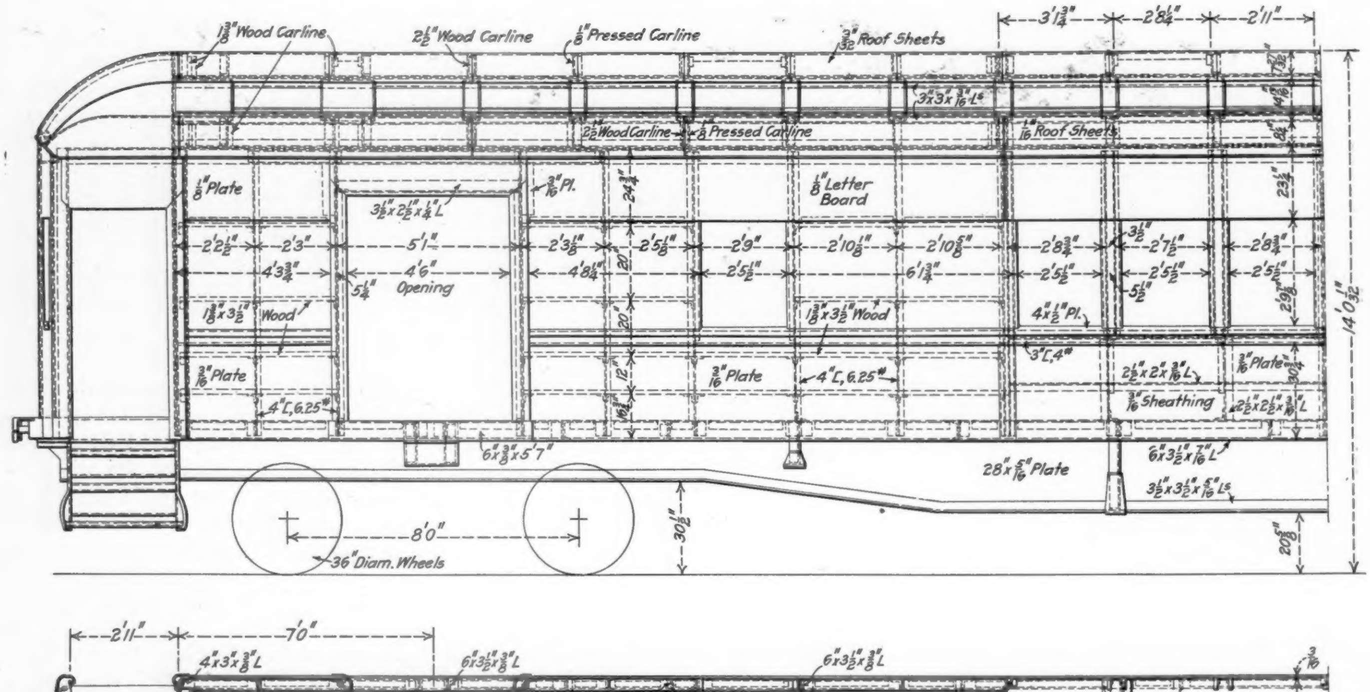
Steel Coach for the Central of New Jersey



Floor Plan of the Combination Car

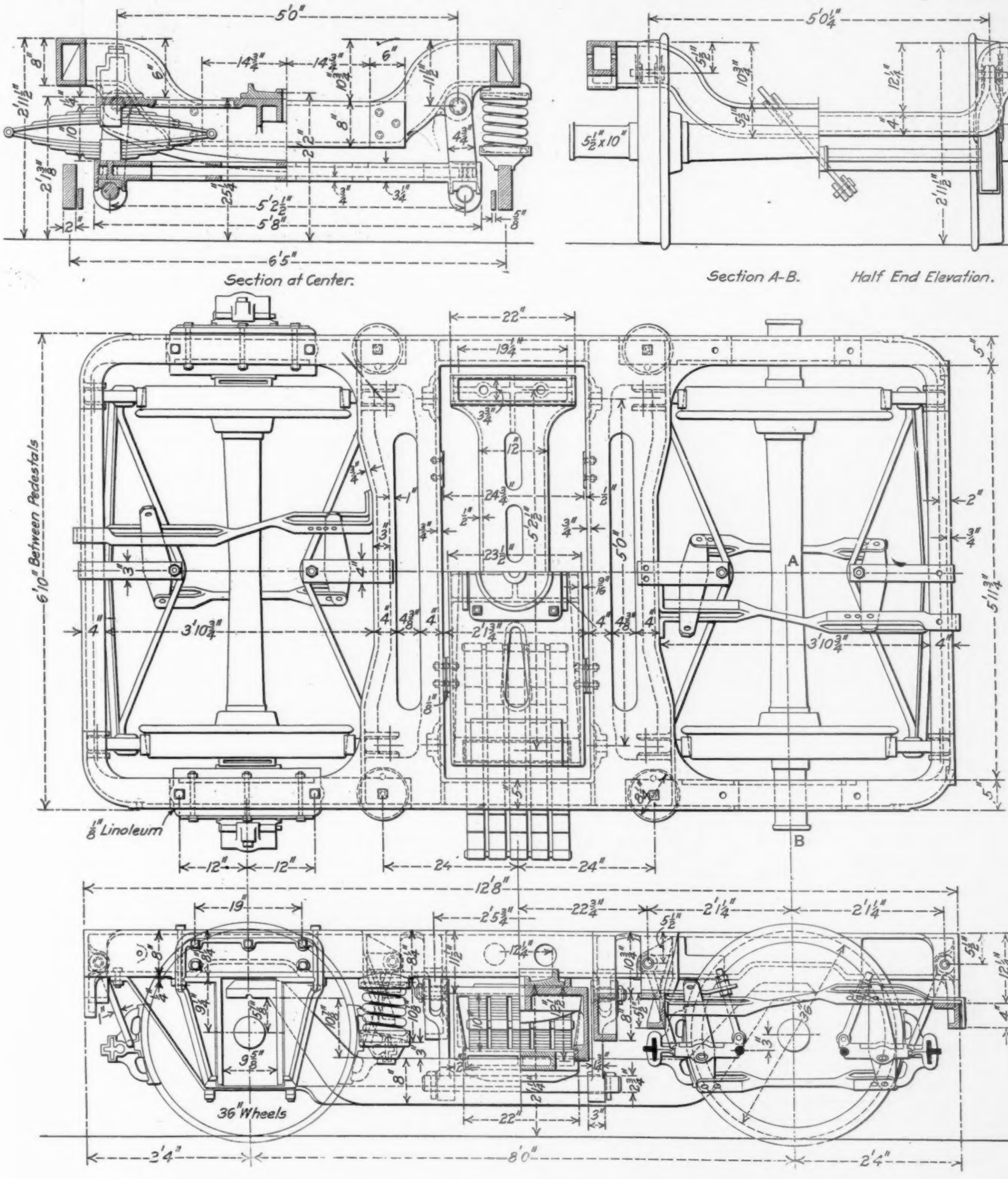


Steel Center Sill Construction Used in the Underframes



Arrangement of the Framing in the Car Body

are placed 8 ft. 9 in. beyond these, and 10 ft. 1 in. from the center line of the body bolsters. The crossbearers are all built up of 5/16 in. pressed steel diaphragms, a 9 in. by 3/8 in. top cover plate being used on all four of them, and extending the full width of the car, while the main or center crossbearers have tie plates 3/8 in. by 6 in. and 5 ft. 9 in. long, and the intermediate crossbearers 5/8 in. by 6 in. tie plates, 5 ft. 6 in. long. The cross ties or floor supports are 6 in., 8 lb. channels.



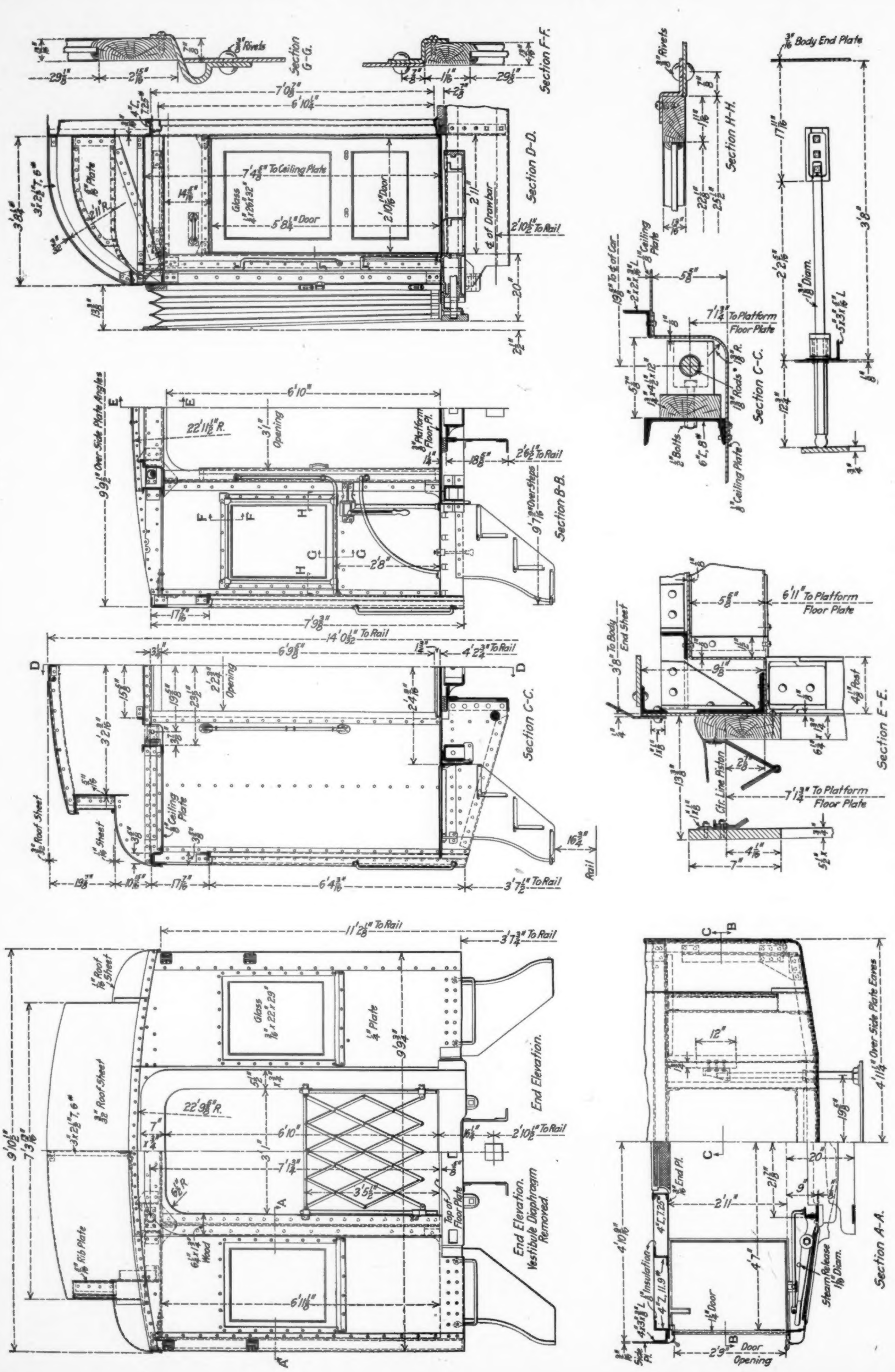
Four-Wheel Steel Truck with Clasp Brake Rigging Used on the Central of New Jersey Steel Cars

BODY FRAME

The side posts are 3 in., 6 lb. channels, and the belt rail consists of a 4 in. by 1/2 in. bar outside, and a 4 in. by 1/4 in. bar inside, with a 3 in., 4 lb. channel separator with the back turned upward riveted between them. Yellow pine fillers are placed between the channel uprights and between the saloon bulkheads of the car for the purpose of attaching the interior wood trim. The side sheathing is 3/16 in. steel plate, while a 1/8 in. plate runs the length of the car body over the window. The side plate is a 5 in. by 3 in. by 5/16 in. angle with the 5 in. leg downward and riveted to the side posts; to the 3 in. leg there is riveted a 5 in. by 1/4 in. plate, to the inner edge and on top of which is riveted a 2 1/2 in. by 2 1/2 in. by 1/4 in. angle.

ROOF

In the roof construction 1/8 in. pressed steel car lines are riveted to the side plate and to the ventilator rail or deck side



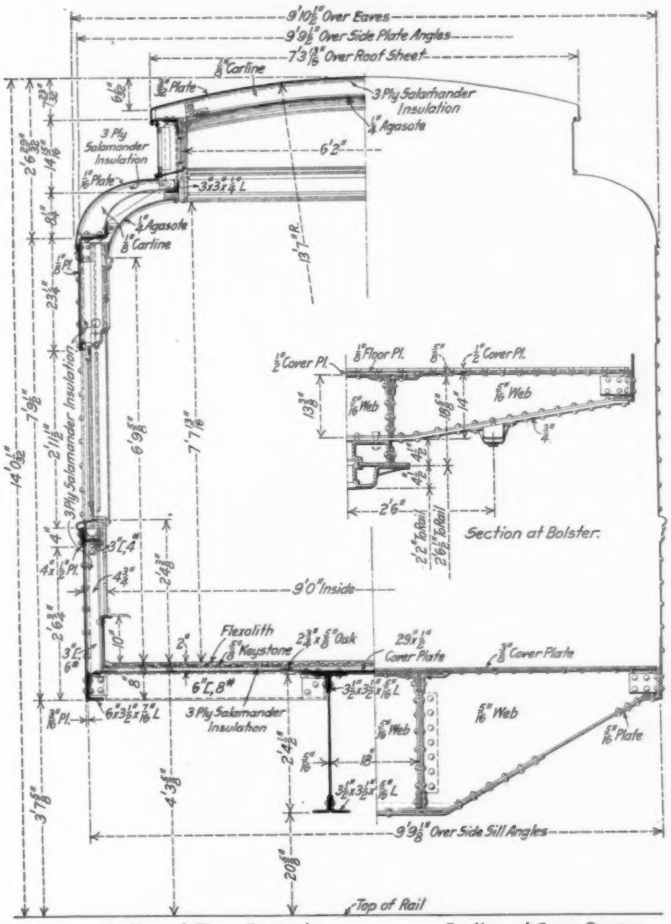
End Arrangement of the Central of New Jersey Steel Cars

sill, which is a 3 in. by 3 in. by 1/4 in. angle. The two deck plates are also 3 in. by 3 in. by 1/4 in. angles, with 1/8 in. pressed steel carlines connecting them. The lower deck roof sheets are 1/16 in. plates and the upper deck 3/32 in. plates.

END CONSTRUCTION

The end sill of the body of the car is a 20 in. by 1/2 in. steel plate riveted to the center sill and connected to the 3/16 in. vertical end plates by angles. The center or door posts are 4 in., 7 1/4 lb. channels, while between each door post and the corner post there is placed a 4 in., 11.9 lb. Z-bar. A Z-bar of the same size is employed at the corner, and to this is riveted a 4 in. by 3 in. by 3/8 in. angle, the 4 in. leg of which is connected to the 3/16 in. side sheathing of the car. These end posts are connected by 49 in. by 8 ft. 10 1/16 in. by 3/16 in plates, and at the top by a 4 in., 7 1/4 lb. channel forming the end plate of the car.

The platform end sill is of cast steel and the vestibule corner



Cross Sections of the Jersey Central Steel Cars

posts are 4 in. by 3 in. by 3/8 in. angles, while the center or diaphragm posts are built up of a 4 in., 11.9 lb. Z-bar riveted to a 3 in. by 3 in. by 3/8 in. angle. The vestibule end plate is a 5 in. by 3 in. by 5/16 in. angle and 6 in., 8 lb. channels connect this with the body end plate at points 23 1/2 in. on either side of the center line of the car. The vestibule end sheathing is 1/8 in. plate.

FLOOR AND INSULATION

The flooring sheets are 1/8 in. plate, and are riveted to the 6 in. channel floor supports. On top of the floor plates is placed three-ply Salamander insulation and on top of this No. 22 Keystone floor plates, which are bolted through the 1/8 in. floor plates; Flexolith, 5/8 in. thick forms the final floor layer.

The insulation for the entire car on the interior, including the roof, is of three-ply Salamander fastened to the steel plates by special malleable nails. These nails are spot welded to the plates, and the Salamander is placed over them after which they are clinched over the insulation. The interior finish is of mahogany with inlay striping. The headlining for both the lower and upper decks is 1/4 in. fireproof Agasote.

TRUCKS

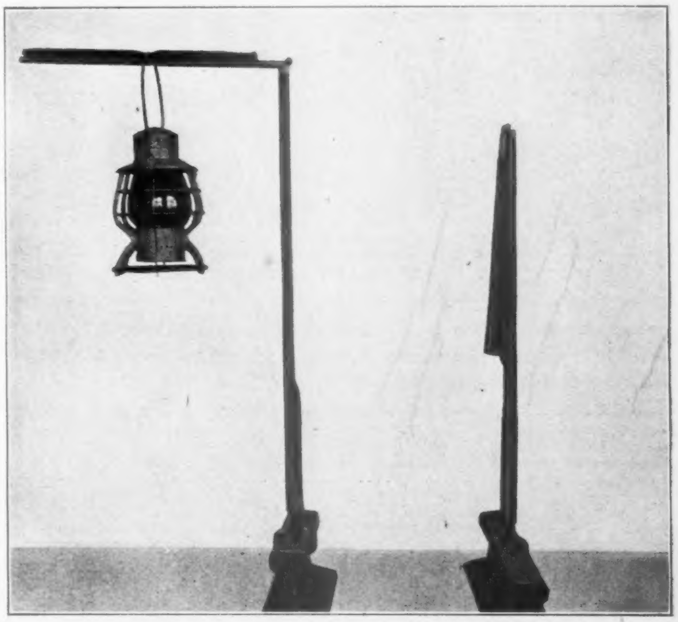
The cars are mounted on four-wheel trucks which have the Commonwealth cast steel frame and are equipped with clasp brakes. They have 5 1/2 in. by 10 in. journals, 36 in. diameter wheels and a wheel base of 8 ft.

OTHER DETAILS

The weight of the coach is 115,800 lb. complete and of the combination car is 115,400 lb. Two of the coaches are fitted with the Ward ventilator, and the balance of the equipment has the plain deck sash ventilator. There are 15 cars equipped with the Acme simplex diaphragm, while the balance have the Ajax, and 30 cars have the Acme vestibule curtains while the balance have the ordinary roller and curtain. The special equipment also includes Edwards trap doors; Gould couplers, friction buffer and draft gear; American Mason safety treads; Ward vapor system of heating; Hale & Kilburn seats; O. M. Edwards Company window fixtures; National Lock Washer Company's cam curtain fixtures with Hartshorne rollers and Pantasote curtains. Davis No. 4 brake beams with Diamond S brake shoes made by the American Brake Shoe & Foundry Company are used, and the cars are equipped with the Woods body side bearings. The lighting system is the Safety Car Heating & Lighting Company's axle light equipment with type F regulation.

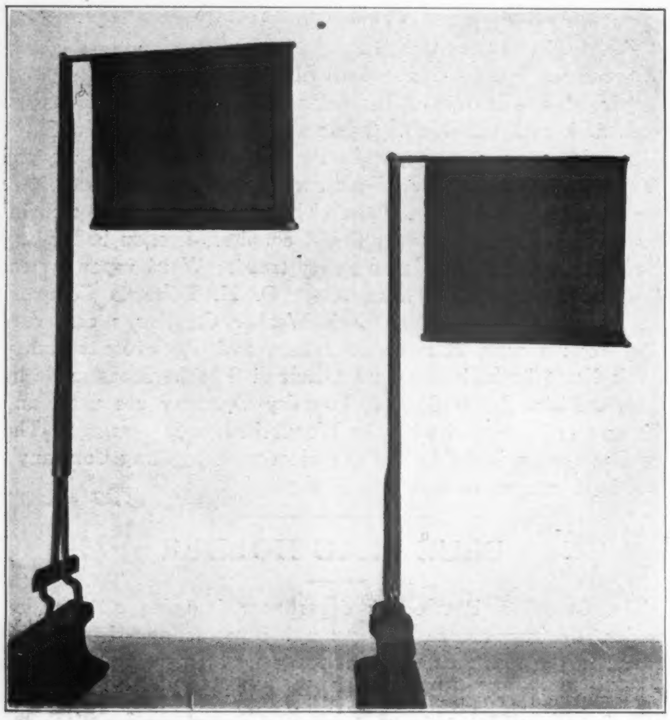
BLUE FLAG HOLDER

The Canadian Pacific car department is using a blue flag holder, the appearance and general construction of which is shown in the illustrations. It is made up of a spring clamp for gripping the rail head, made of one piece of 5/8 in. half-round iron, a foot piece 1 1/2 in. by 1/8 in. by 4 1/2 in., and a mast made of 1 1/4 in. outside diameter, seamless tubing, 1/16 in. thick and 32 in. long. The mast is cylindrical for a distance of 9 in. from the lower end and above this point one side is pressed in so that the cross section is crescent shape, thus forming a recess that permits the flag, when wrapped around the cross bar, to be folded so that it is compact and convenient to carry. The flag is secured to the cross bar by means of a light strip of metal and



Blue Flag Holder Arranged for Night Service, and Folded

four small stove bolts and the lower edge is weighted with a piece of steel bar, thus ensuring the full area always being in view regardless of wind conditions. This is an important feature, as the ordinary flag attached to a perpendicular mast hangs limp when the wind is not blowing, and if attached to a stick that is horizontal the flag may not be very conspicuous if the wind is blowing strongly from the direction of the observer. This device is of equal service at night, the only change required being to wrap the flag around the cross bar and hang a lantern over the bar, the folds of the flag serving to prevent the lantern from creeping off.



Blue Flag Holder Being Placed on a Rail, and After It Is in Position

One of the most important advantages of this flag holder is the making possible the enforcement of rules requiring that flags be located a specified distance away from the car to be protected. This is important, as flags displayed against a dark object, such as a car painted black, are not as conspicuous as they would be if placed some distance in front of it.

New Metal for Bushings.—Graphalloy, a new metal, which has recently been produced for the construction of self-lubricating bushings, and which is pure graphite impregnated under pressure with either babbitt, lead, bronze or copper, has the following mechanical properties:

Increase of weight due to impregnation, percentage	150
Percentage of metal in graphalloy by weight	60
Percentage of metal in graphalloy by volume	25
Compressive strength of graphalloy	14,000 lb. per sq. in.
Modulus of rupture	12,500

Improving the Burning of Coal.—There has recently been put upon the market in Germany quite a flood of preparations for the purpose of making a brew in which coal or coke is to be wetted before being put upon the fire. The alleged result of using these preparations is that the coal burns more readily and that there is a great saving in the amount of fuel required. Herr T. Oryno, of the laboratory of the Berlin Fermentation Institue, has analyzed a number of these preparations and found them to consist of various salts such as sulphate of magnesia, sulphate of soda, common salt, nitrate of soda, and so on generally with a small proportion of oxide of iron. He concludes that they cannot have the effects attributed to them.—*The Engineer.*

THE GREATEST WEAKNESSES IN BOX CARS*

BY R. P. BLAKE
Master Mechanic, Northern Pacific, Dilworth, Minn.

The box car as developed in this country has two principal functions—the transportation of material and the protection of its contents from loss or damage by theft or from the action of the weather. Its development from the car of 30 to 33 ft. length and a capacity of 20 to 25 tons and 1,500 to 1,650 cu. ft., with wooden roof, oak sills and short draft timbers, to the modern car of 36 to 40 ft. length, with a capacity of 40 to 50 tons and 2,750 to 3,000 cu. ft., with metal covered roof, steel underframes and reinforcements of steel in various parts, has been the result of the changes that have taken place in railroad operation. Between these two types of cars are those with many variations in size, capacity and minor details of construction which constitute the greater number of cars that are in actual service at the present time.

Box-car construction in this country in the past has suffered perhaps more than any other single item in railroad development from the blighting influence of first cost; but today it is generally understood that while first cost must not be lost sight of, yet cars which, due to cheapness in construction, are not of ample strength, will in actual service produce operating costs in the accounts of maintenance, loss and damage to contents, and delays to shipments that far overbalance the saving in construction. Again, admitting that there is an increase in the cost of hauling freight as the dead weight of the car increases, this is soon wiped out by the increased earning capacity secured by having a car that very rarely goes to the repair track and only in case of wreck has to be sent to a shop.

The fundamental principle underlying all satisfactory construction is a durable foundation, and this applies with special force to box cars. The underframe construction is today the weakest part of a great majority of box cars in service, and until it is reinforced to provide a rigid base upon which the body can be securely fastened, our troubles will continue in ever-increasing numbers. The increased necessity for larger train units to reduce operating costs has resulted in a great increase in the shocks met in daily service, and it is these heavier shocks that, frequently repeated, sooner or later shatter the draft rigging connections to the underframe of the car and loosen the roofs, posts and braces. The load on a bridge and the resultant stresses can be readily determined by accurate calculations and the proper factor of safety provided. In a similar manner, many parts of a locomotive can be designed so as to insure satisfactory results. But box-car construction is quite different, and the necessary strength of a car frame or body to withstand properly the various service shocks, which in many cases are only generally known, is largely a matter of careful observation of service conditions and must be based more on experience than calculation.

The experience with steel cars designed for handling coal and ore has demonstrated that it is possible to construct a car that can and will meet fully the requirements of modern train service, and it is this type of construction that is now generally recognized as necessary to obtain a satisfactory car. Again, the introduction of steel underframe construction so generally in new work has resulted in concentrating the effects of service shocks upon the weaker wooden underframe cars in a train and the deterioration of wooden cars is increasing in a marked degree. The steel center sill that is interchangeable with wooden sills, is the only proper remedy for this defect, and the resultant stiffness will more than pay for the slightly increased cost. A better method of securing the draft rigging is provided, and a reduction made in the straining of the body that ordinarily comes from a weak underframe that will not carry the load.

*Awarded the first prize of $50 in the car department competition which closed October 15, 1914.

Having provided for this, the greatest weakness in box car conditions, by making a car that should be available for transporting material a maximum proportion of the time, the question of the protection of the contents from damage must also be considered. The class of material to be handled is of vital importance, and weakness in construction develops accordingly; but generally speaking, the order in which it occurs is, first in the roof, next in the side doors and fixtures, and last in the door posts and end posts.

The weaving of a box car in service, due to inequalities in the track and the inertia of its own superstructure, especially under switching shocks, has been greatly increased in the larger cars of more recent construction, and can only be overcome by greater strength in design. The roof frame must not only be securely fastened to the body, but must be firmly cross braced, as without this cross bracing the best of waterproof covering will become loosened and leak and often in case of severe wind be torn entirely from its place. Various forms of steel carlines are giving excellent service, as they can easily be applied to fully meet the requirements of the service. The present wooden roof construction can be greatly reinforced with little additional cost by making the surface circular and fastening the roof boards diagonally across the car, which provides a light yet very strong construction and gives a proper foundation for the weatherproof covering.

One of the greatest sources of loss of contents from box cars by theft is directly chargeable to side doors and fixtures. Doors which do not slide freely are soon damaged by shippers in opening and closing, and it is hard to keep such doors properly closed on empties, with the result that the impact of switching and service shocks causes frequent damage. Roller fixtures should be secured so they cannot get out of place under jars from service shocks and should have proper clearance so that the door cannot bind. Bottom door guides should be securely fastened with nuts riveted over so that they cannot be readily removed and should have a flange high enough to prevent any possibility of the door, even when slightly damaged, swinging out from the side of the car. Front door stops should be of metal, to provide a rigid connection for the hasp and fixtures and proper reinforcement for the door post. The hasp fastener should be secured directly to the frame of the door, as otherwise the boards of the door will be torn from the frame.

Cars used to transport lumber and similar commodities, also for bulk shipments, such as grain, coal, lime, etc., are liable to additional strains from shifting of the load and the bulging effect which causes frequent failures of end and door posts. This is one of the greatest causes of loss and damage claims in bulk grain shipment and a frequent cause of delay in lumber shipment. The only way to provide proper strength in end posts is to have them held in place by substantial pocket and cap castings, securely fastened at the top and bottom to the frame; the posts should be reinforced by using either a metal flitch plate or an I-beam. The end lining should not be less than 1¾ in. in thickness to properly distribute the shocks over the entire end.

The bulging of door posts is not as a rule the result of such severe shocks as come on the end posts, but weakness at this point is common and difficult to determine from an outside inspection before loading. The pocket at the bottom of the post should be particularly strong and securely fastened to the side sill in such a manner as to prevent the post tipping out.

These items cover the chief causes of loss, damage and delays on account of weakness in box-car construction. The remedies proposed will give a car of sufficient strength to continue almost constantly in service with low cost of maintenance and very few claims for loss or damage that can be charged to the construction of the car. The good will of the shipper can best be secured and held by removing the causes of loss and damage, and it is one of the factors that must be seriously considered in determining the cost and efficiency of a box car.

WOODEN CARS IN FREIGHT TRAINS

On page 581 of the November number there was published an abstract of a paper on "Wooden Cars in Freight Trains," read before the Canadian Railway Club, Montreal, Que., October 13, 1914, by G. E. Smart, Master Car Builder, Intercolonial Railway, Moncton, N. B. The following is taken from the discussion of the paper:

W. O. Thompson, District M. C. B., N. Y. C., Buffalo: The draft gear problem is one of the most serious and expensive ones on old cars all over the country. I have noticed when cars were damaged that were equipped with the modern draft gear, it was not the gear that was damaged, but the rest of the car, showing that our friends in the draft gear business are fully alive to modern requirements and have the gear for you any time you want it.

As to the matter of rough switching in yards, yard motive power has increased in capacity in the same ratio as road motive power, and time is a great factor on railroads. We cannot any more reasonably expect our old freight car equipment to stand the switching service in yards any more than it will stand the work out on the road.

The wooden car has not much of a chance. It is not expected that it will have. The only thing that can be suggested at the present time in handling wooden cars is to keep them in the rear of the train, but there are a good many arguments against that practice. It takes time and costs a good deal of money to keep them switched in the rear of trains at all times where they will be comparatively safe.

On a road with which I was connected a few years ago the question came up about putting the old wooden equipment in condition to stand the severe service of the present day, and upon investigation it was found it would cost about $200 per car. One of the master car builders said that if the management would commence that work at once and continue it to the time when the wooden equipment would be fully equipped, in five years their repair bills would be cut in half and every cent expended in such improvements would return within that time. The recommendation was accepted and acted upon and the matter is being watched very carefully. During the severe business depression that company has only worked about 60 per cent of their force, and after about a year of such depression they only have, approximately, four per cent of their freight car equipment held for repairs.

I noticed in one paragraph of Mr. Smart's paper that he speaks of applying different types of steel draft arms to the present wooden center sills in such a manner that it reinforces the center sills, thus greatly reducing the cost of strengthening the car. That, in my opinion, is the poorest kind of policy to be pursued. You can build a good, substantial, repair steel underframe for about $150. The steel draft arms will cost about $60; the salvage on the steel underframe when you get through with it is worth $50. The steel draft arms at the best are only a poor makeshift and do not in any way serve the purpose intended, while the properly designed repair steel underframe is good as long as you want to run the car with practically no further repairs necessary. I may say the same thing about the channel makeshift.

I believe the thirty, forty and fifty thousand pounds capacity cars should be done away with at once. The cars of higher capacity with wooden underframes that it is desired to maintain should have a good, substantial underframe under them so that they will stand the shocks.

R. W. Burnett, Gen'l M. C. B., Can. Pac.: Mr. Smart's paper comes at an opportune time, as the Master Car Builders' Association have just passed a rule that after October 1, 1916, all cars of less than 60,000 lb. capacity with draft arms which do not extend beyond the body bolster will not be accepted in interchange, and as it is only a question of time until this will be extended to

cars of higher capacity, it would be unfortunate if some of the roads should equip their cars with metal draft arms not extending a sufficient distance behind the bolster, and later a rule be passed for these heavier cars that the metal draft arms should extend some specified distance a few inches beyond the arms with which a large number of cars had already been equipped. I mention this particularly as there are designs of arms extending only to the rear edge of the bolster which could easily be extended a sufficient distance.

Referring to Mr. Thompson's criticisms on reinforcements, which he considers too light, it has been my good fortune to have had considerable to do with the designing and use of steel center sills, metal draft arms and end reinforcements. Our method of underframe reinforcements has been largely at variance with that of nearly every road in the country. We have a six-inch Z-bar center sill which many consider too light, but our experience with this arrangement has been entirely satisfactory. In designing the reinforcements we have utilized the resiliency of the old car, working in harmony with the metal reinforcement that we apply. Of 14,000 old and new cars equipped with these sills during the last few years, a carefully kept record shows that repairs had been made to the sills of 74 of these cars, and these were largely on the first cars equipped, on which the sills were not so securely attached to the end sills as is now the case, and that the damage was largely due to rough handling. There has also been only one case where a foreign road has rendered bill for repairs to these sills on account of owner's defect. In nearly all of the 74 cases referred to, the sills were simply jacked back in place and more securely attached to the end sill and continued in service.

In the reasons given by Mr. Smart for failed sills and draft attachments, I believe he has omitted one of the most important, if not the most important, cause. I refer to the congestion due to heavy business on a single track road with consequent sawing by of trains. I believe this does more damage to draft attachments than yard service.

T. J. O'Donnell, Arbitrator, Niagara Frontier Car Inspection Association, Buffalo: There is no question that the points brought out by Mr. Burnett are worthy of serious consideration, but I really feel, with all due respect, that Mr. Thompson has the keynote to the situation and the necessary money required would be a very good investment.

Damages to cars in the different switching yards must be considered under the heading of ordinary handling; the operating officers are after their yardmasters for prompt service in getting trains out of the different yards, and naturally the yardmasters are obliged to make good and the severe handling is more or less universal.

The American Railway Association has more or less adopted the rules, which are now in the M. C. B. rules, that permit the transfer of cars that are unfit for service, and the receiving line should take advantage of this rule. We are obliged to in the Niagara Frontier to the extent of about 2,000 cars each month. There is no question that if some roads do not find it consistent to apply the steel underframe, the extension of draft timbers through the bolsters and the application of proper metal bolsters will greatly improve the equipment.

W. O. Thompson: When our arbitrator states that we transfer 2,000 cars a month in the Niagara Frontier it causes me to wonder how many cars are being transferred in the United States each month on account of the old wooden underframe cars. If there are 2,000 cars transferred in the Frontier, at a minimum cost of $6 per car, it would mean $12,000. There are probably 100,000 cars transferred in the United States every month under similar conditions, on account of defects. It seems to me that the cost of this work, at $6 per car, would soon put steel underframes under all the cars that are to be maintained in the United States.

L. C. Ord, Asst. M. C. B., Can. Pac., chairman: Mr. Thompson's remarks about putting heavier underframes on cars have two viewpoints. There is a difference between half a loaf and no bread. Mr. Burnett brought out the other side of the question. The Master Car Builders' Association felt that the wooden cars would stay in service if they got rid of the short wooden draft timbers, as the car with the short draft timber fails rapidly in hard service and is liable to block the track. The long draft arm running behind the bolster may fail, but you can catch it in time before serious failure takes place.

An important item is the view taken by operating officers of damage, particularly to draft gear. I was called into the office some time ago and the officer told me that though we had done quite a lot of draft gear work, if we did not follow up rough switching we would again lose ground. It is not altogether a question of getting something strong enough, as yardmen will always work up to the limit of damage. It is much more a matter that when damage occurs it should be followed up sharply to prevent a recurrence. Merely making the repairs is not sufficient in cases where unfair service caused the damage.

In regard to the short draft gear question, we have a lot of short draft gear cars and will have them for a long time to come. There are cars on which if we attempted to fit them with heavy underframes, the work could not be done quickly enough, and further, we would not get the value out of it because we could not wear the gear out by the time the car would be retired from service.

As soon as the operating officers recognize that it is necessary to protect themselves and their expenses we will get better results, but the trouble has been that the case has not been clearly or strongly enough put.

W. R. McMunn, General Car Inspector, N. Y. C.: On the line with which I am connected we are experiencing a great deal of trouble with failures of cars having short draft timbers and, regardless of the fact that we have instructions in force whereby such cars must not be operated ahead of 15 cars from caboose, this does not wholly relieve the situation. I imagine that on roads where there are no such restrictions the number of failures would be measurably greater.

Rule No. 3 of the current M. C. B. Code provides that "After October 1, 1916, all cars of less than 60,000 lb. capacity, having wooden or metal draft arms which do not extend beyond the body bolster, will not be accepted in interchange." This is the first definite step taken by the association to exclude this class of undesirable equipment from interchange. In my opinion it will be only a few years till no car will be offered in interchange unless of all steel or steel underframe construction. This will, to a certain extent, work itself out automatically by reason of the car owner being made responsible from year to year for a greater number of defects on his car by the abolition of the combinations in rules 40 to 42, inclusive. When this is done, and I am confident it will be within a few years, roads having this weakly constructed equipment will see the wisdom of properly strengthening it or keeping it in service on their own rails.

The New York Central seems to have anticipated this condition to a greater extent than many other roads, for we have applied steel underframes to about 14,000 of our older cars of all classes within the past few years, and by some we are considered pioneers in the work. It is surprising, too, to see how well these cars are standing up in service. Bills for repairs are reduced to a minimum, there is no necessity for switching cars to the rear of trains, which is expensive, and we have the cars in service at all times instead of their being held on cripple tracks half the time awaiting or undergoing heavy repairs.

Of course, there are many of the lighter capacity cars not worth spending a great deal of money on, but by process of elimination these are rapidly reduced and with M. C. B. Rule 120 to help us out, we should in the near future be able to realize our ambitions of having cars offered to us that we need not be skeptical about running and which will, under ordinary conditions, take a load to its destination without the necessity of being cut out for repairs at practically every inspection point en route.

SHOP PRACTICE

REPAIR WORK AT SMALL ENGINE HOUSES*

BY G. H. ROBERTS
General Foreman, Lehigh Valley, Cortland, N. Y.

The primary object of an engine house is to care for locomotives while they are in service and keep them in service as constantly as possible by doing the "stitch in time" jobs before they develop into large ones. Inspection is a most important item about a locomotive and of course the work which is reported should be done else the inspection will be worthless. Cracked spring rigging, rods or brake rigging, nuts loose or missing, are items which, if not corrected, develop into large jobs by leaps and bounds. No matter what the facilities are, if the small jobs are not detected and remedied the power will quickly go to pieces.

Recently the writer was discussing the mileage made by a certain locomotive with an inspector who is not connected with the railroad, and who made this remark: "Why wouldn't the engine make that mileage? It was looked over every trip and every little thing was done that possibly could be." If this engine made a phenomenal mileage by having every little job done as soon as it developed, why can not each engine receive practically such attention? Of course, in some sections the conditions, such as a hilly road full of curves, are against high mileage, but even there with flange oilers the tires can be run a great deal longer than without them, and the mileage made by tires and flues usually determines the shopping limit.

The following rules if lived up to will go far toward keeping engines in service: Keep the guides lined as close as possible, the wedges set up and the rods in good order; keep the engines up on their springs; watch for low pilots before they catch on a crossing plank and are torn off, causing great damage; keep the flues cleaned, the grates in first-class condition and in superheater locomotives keep the superheater tubes cleaned out or the superheater will not perform its work economically. Most of the trouble from piston rod packing blowing can be traced directly to play in the guides or to small pistons.

Water as hot as it is possible to use it should be used for washing out; this will help to prevent the breaking of staybolts and the cracking of sheets. At washout time all boxes should be thoroughly inspected and packed, as frequently washout water will destroy the packing. Keep all the slack possible out of the driver brake hangers as it increases rapidly if not checked, and results in damage by permitting other parts to tear loose. The brake rigging gets more use and abuse than any other part and therefore requires close inspection and thorough repairs.

The smaller engine houses have not the facilities that the larger ones have, but the work can be accomplished easier and cheaper by making a plain rough sketch of such parts as spring hangers, shoes, wedges, etc., and obtaining them from a large shop, ready to apply. Where the facilities are at hand for producing them cheaply, a small quantity of such parts, if standard, can be carried in stock for immediate use. This applies to the older classes of power, fast dying out, and not so much to later locomotives that have a great many parts interchangeable.

Frequently simple devices can be applied to a locomotive and save considerable time and labor in accomplishing the same results as the longer way would. For instance, with the single rail front frames trouble is found in keeping them from working on the cylinders, as the bolts do not seem sufficient to hold them in place. By applying a clamp across the top of the cylinder directly over the rail of the frame, using a piece of small section rail of about 56 lb., and vertical rods at the front and back of the cylinders placed as close as possible, the trouble can be overcome. The writer has tried this many times and always successfully. The clamp takes about two hours to apply, while to remove the pilot, run the truck out and rebolt the frame would require about two days, and the clamp answers the purpose even better than the bolt alone. This clamp acts similarly to a double rail front frame.

With the laws becoming more rigid every year the care and inspection of the locomotive boiler is the greatest item in roundhouse work. Every trip the boiler must be inspected for leaks and repaired, and all broken staybolts renewed. For years it has been the universal practice to plug the broken staybolts when only two or three existed and they were scattered, but now telltale holes must be kept open at all times. By having strict inspection, and keeping plenty of the various sizes and lengths of staybolts on hand at all times, this work is greatly facilitated. Defective welds in tubes that have withstood a test and a few months service can be easily detected by applying about 25 lb. pressure to the boiler and placing a light at the opposite end of the tubes from the inspector. If done at every washout this will eliminate burst tubes in service.

Because of inspections and laws becoming more rigid, engine houses need better machine and tool equipment. A ten-stall engine house, handling 30 to 40 engines a day should have the following equipment:

1 36 in. engine lathe	1 radial drill
1 24 in. engine lathe	1 36 in. by 36 in. planer
1 16 in. engine lathe	2 emery wheel stands
1 sensitive drill	

Also a drop pit for engine and tender truck wheels, a portable crane for steam chest work, a hot water system for boiler washing, a motor-equipped turntable, two air motors with capacity for 1¼ in. drills, a breast air motor for tell-tale holes and an air compressor. A hot air system of heating avoids steam leaks in severe weather; steam pipes in the pits also cause steam in the engine house because of drippings from the engines falling on them.

A good tool room with pockets for each tool is desirable as the tools in engine houses are often needed quickly and should be in a place where they can be readily obtained. A good tool room aids in keeping the place tidy as when tools and stock are kept in their places anything left lying around must be scrap, which the laborers keep picked up. Time spent hunting for tools is a loss and does a great deal to hold the work back.

Motor drive can accomplish a great saving in an engine house. In one instance a 7½ h. p. motor was installed to replace a stationary engine and it has saved about 75 tons of coal per month. The engine had to be run practically continuously as it was not easily started and stopped, while the motor can be stopped and started very easily and is run only when needed. A separate motor-driven fan was installed for the blacksmith forge, making it independent of the line shafting. The steam engine was isolated and the exhaust could not be turned into the stack for draft. However, after installing the motor the exhaust from the air and water pumps adjacent to the boiler was turned into the stack and practically did away with the use of the blower to keep up steam. This saves considerable coal as the blower was used almost continuously. Formerly two boilers were run in the winter months but since the motor was installed and the exhausts used, one boiler has furnished an ample supply of steam during the most severe weather. In addition the one boiler supplies steam to the ash track for cleaning the ash pans; the two boilers did not have this additional duty.

A steam line was laid to the ash track for use in thawing out

*Entered in the competition on Engine House Work, which closed July 15, 1914.

hopper ash pans in winter. Formerly an engine equipped with steam heat was used and the inconvenience has been greatly reduced by the steam line. The handling of engines in the ash track is a hard task in severe weather. During very severe weather we run engines directly into the engine house from the road and thaw them out before hostling them, saving considerable time on the ash pit. Much trouble with the turntable was caused by ice forming around the center pin and freezing it solid. By applying a steam coil around the center this was avoided. The steam used is taken from the sand dryer, making it serve a double purpose.

A great saving in time can be made by watching the work reports as the locomotives arrive. For instance, if an engine has given trouble with grates of the longitudinal type, by not coaling the engine before it is placed in the engine house the grates and bars can be removed, repaired and replaced without cutting the engine and tender apart, which takes considerable time. This one item will save at least one hour on the repairing of the grates. Frequently a tank will need repairs and if it is noted in time and the tender is not coaled, it saves unloading it, which takes about two hours. The same consideration applies to sand; when the sand box is to be repaired the hostler should be notified not to sand the engine.

Close inspection at all times and the use of all possible short cuts will go far toward keeping up the power. The personal element enters the work more than the equipment available; an engine can receive just as good an inspection at a small engine house as in the most up to date shop. Inspection is the most important item in engine house work.

PATCHING BOILERS ACCORDING TO LAW

BY GEORGE G. LYNCH

Because of the use of the patch bolt and the outside plate for so many years in hurry up jobs of locomotive boiler repairing, with the size and spacing of rivets left to the discretion of the average repair shop foreman, it is hard to bring about a proper appreciation of the necessity for calculation of the tension in the plate and the shearing stress upon the rivet or patch bolt to insure a condition of perfect safety. But since the federal boiler inspection law has been in force, the necessity arises for the actual calculation of stresses in designing boiler patches, so that they will have a theoretical factor of safety of not less than four. It is the purpose of this article to present the facts in such a way that the average shop man will be in a position to recognize the importance of the calculations, and to carry out the work so that the boiler will actually have the strength that is theoretically claimed for it.

For boilers made of plate and rivets of unknown strength the law allows the following ultimate stresses: tension in steel plate, 50,000 lb. per sq. in.; tension in iron plate, 45,000 lb. per sq. in.; shearing stress in steel rivets, 44,000 lb. per sq. in., and shearing stress in iron rivets, 38,000 lb. per sq. in. These figures divided by four, or the factor of safety, give the actual maximum stress that may be created in the plate or rivet by the steam pressure within the boiler.

The resultant force of the steam pressure which produces a tearing effect upon the plate and a shear upon the rivets will best be understood by reference to Fig. 1, which shows the steam pressure acting in opposite directions tending to burst the shell. Let the steam pressure in pounds per square inch $= P$, the inside diameter of shell $= D$, the inside radius of shell $= R$, and let $p =$ a unit length of the boiler shell. Then $P \times D \times p =$ the stress upon both sides for a unit length, or $P \times R \times p =$ the stress upon one side for a unit length. This shows the tendency of the shell or joint to pull apart when the boiler is under steam pressure.

Now suppose a hole be drilled at each end of the longitudinal distance p, as in Fig. 2. We can readily see that the force upon the length p will be the same while the plate is reduced an amount equal to the diameter of one rivet hole. Then if we let $t =$ the thickness of the plate, we have an area equal to $t \times (p - d)$, which is known as the net section of the plate. This is the condition always found along the line of the outside row of rivets in the longitudinal seams. If the dimensions are given in inches and the pressure P is given in lb. per sq. in., we can readily calculate the tension upon the net section of the plate between any two rivet holes. According to the law this tension must not exceed $50{,}000 \div 4$, or 12,500 lb. per sq. in., for steel

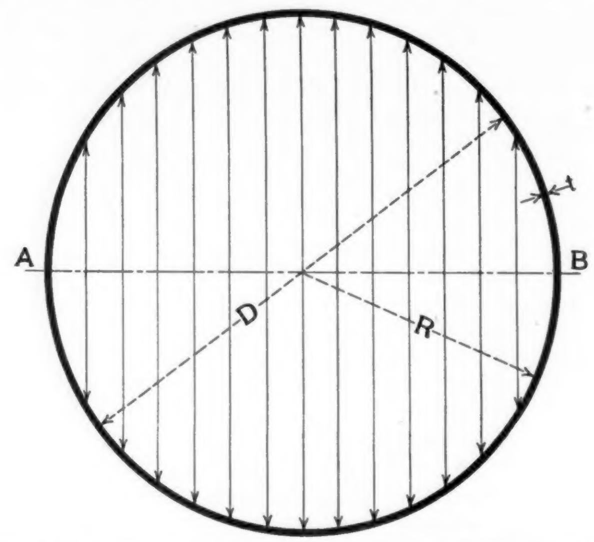


Fig. 1—Action of Steam Pressure, Tending to Burst the Shell

plate of unknown strength, and $45{,}000 \div 4$, or 11,250 lb. per sq. in., for iron plate of unknown strength.

As an example let us assume that we have a boiler with the following dimensions: $P = 175$ lb.; $D = 60$ in.; $R = 30$ in.; $t = 0.5$ in.; p (pitch of outside row of rivets in seam or patch) $= 3$ in.; and d (diameter of rivet holes) $= 13/16$ in. (0.8125 in.). The stress acting for distance p will be equal to $175 \times 30 \times 3 = 15{,}750$ lb. The net section of plate will be equal to $(p - d) \times t = (3 - 0.8125) \times 0.5 = 1.093$ sq. in. Dividing the net section in square inches into the stress, we have the tension per square inch, thus: $15{,}750 \div 1{,}093 = 14{,}409$ lb. per sq.

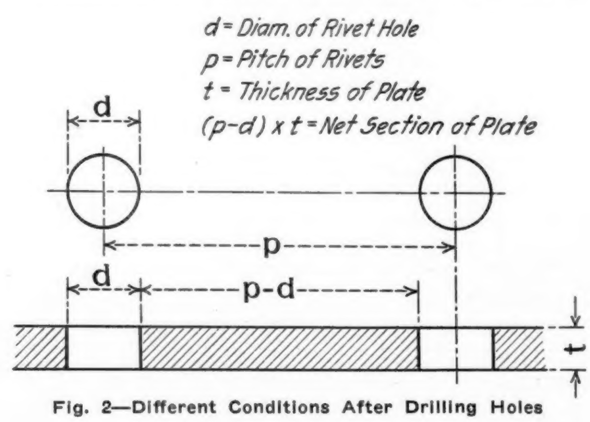


Fig. 2—Different Conditions After Drilling Holes

in., which is too high, giving a factor of safety of $50{,}000 \div 14{,}409 = 3.5$, instead of 4 as required by law.

Assuming that this is a seam with an ordinary double riveted lap joint, with 3 in. pitch, or an outside patch with a double row of rivets along the longitudinal edges, in order to attempt to maintain the steam pressure at 175 lb., we would have to apply an inside cover plate and add an outer row of rivets with 6 in. pitch. Then the tension along the row with 3 in. pitch would be lessened by the shearing value of the outside rivets. In this case we would have $P \times R \times p = 175 \times 30 \times 6 =$

31,500 lb., as the total stress in the net section between the rivets of the outer row; and $(p - d) \times t = (6 - .8125) \times 0.5 = 2.59$ sq. in., as the net section. Stress divided by net section $= 31,500 \div 2.59 = 12,162$ lb. per sq. in., which appears to be

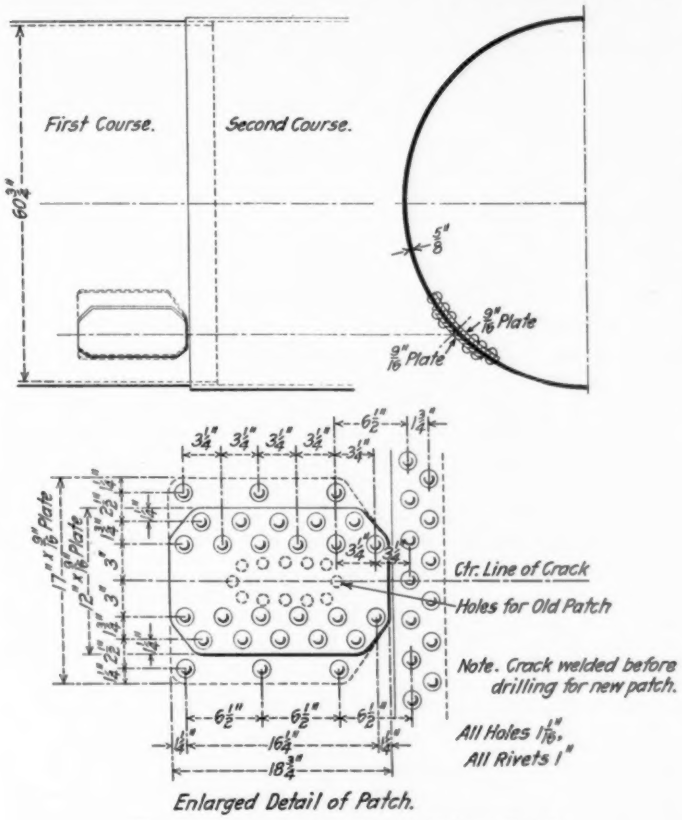


Fig. 3—Replacing an Unsatisfactory Patch

ideal for the tension at the outside row, but the combined tension at the inside row and the shear upon the rivets in the outside row may be too high. In this case the net section is

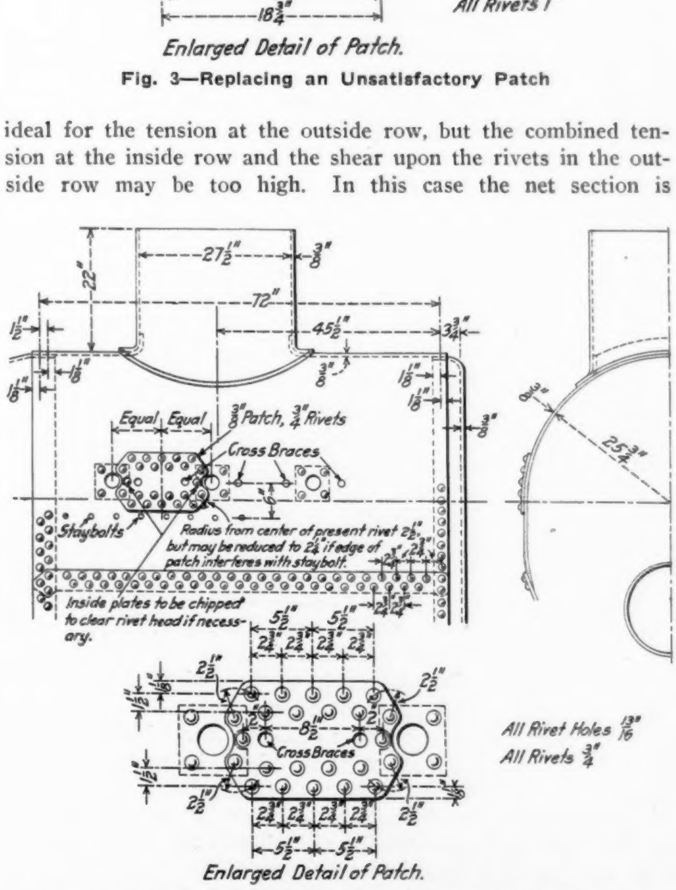


Fig. 4—Difficult Patch Placed Between Two Washout Holes

$(p - 2d) \times t$, as there are two spaces in the inside row for each distance p, in the outside row; and the area of the rivet holes, which are 13/16 in. in diameter, is 0.5185 sq. in. If we assume that the rivets are of steel the shearing stress must not exceed $44,000 \div 4$, or 11,000 lb. per sq. in. The total resistance, then, will be $(p - 2d) \times t \times 12,500 + 0.5185 \times 11,000 = 27,350 + 5,704$, or 33,054 lb. The total stress will be $175 \times 30 \times 6$, or 31,500 lb. In this calculation we find the number of square inches in two net sections of one of the inside rows, and the area of half of two rivet holes in the outside row, multiply the first by its allowed tensile strength per sq. in., and the second by its allowed shearing value per sq. in., add the two values and we have the combined resistance, which must be equal to or greater than the stress acting over the distance p, the pitch in the outside row.

Thus far the joint will be safe after adding the inside welt strip or cover plate, but we have yet to consider the failure by shearing all rivets on one side. In the first case we had a double riveted lap seam with 3 in. pitch, ¾ in. rivets and 13/16 in. holes. The shear on the rivets would be equal to the stress in the net section divided by the area of two rivet holes, or $175 \times 30 \times 3 \div 0.5185 \times 2 = 15,188$ lb. per sq. in. But the law allows only 11,000 lb. per sq. in. for steel rivets in shear and 9,500 lb. per sq. in. for iron rivets. With steel rivets we have a factor of safety of $44,000 \div 15,188$, or only 2.9 instead of 4.

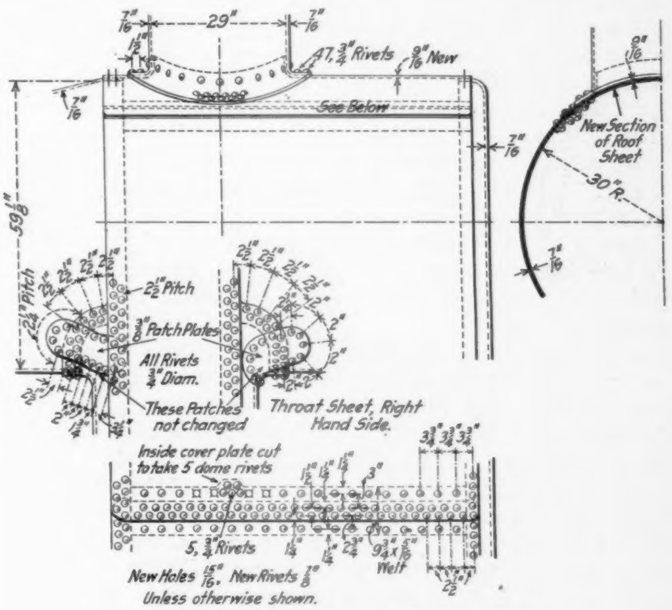


Fig. 5—Application of New Roof Sheet

Therefore, even if the tension upon the net section of the plate had been within the required limit, the shear upon the rivets would have been too high. But the addition of the welt strip gives one more rivet in shear, so we have $175 \times 30 \times 3 \div .5185 \times 3 = 10,125$ lb. per sq. in., which gives a factor of safety of 4.3.

In case the shear upon the rivets were still too high we might increase the size to ⅞ in., but in this case the tension upon the net section would have to be re-calculated, as the holes would be larger and the net section less. Another method would be to leave the rivets at ¾ in. and widen the welt strip so that another row of outside rivets could be added, but this would be rather unusual and it would be better to reduce the pressure to suit the conditions.

The tension on the net section of plate is responsible for the inside cover plate in nearly every case, because the seams have to be calked on the outside and if the rivets are close enough together to make a good calking edge it will nearly always be found that the tension upon the plate is too high. In boilers of high pressure, with double or triple riveted butt seams, the inside cover plates also increase the shearing value of the rivets by causing the inner rows to be in double shear, for which the law allows double the value of single shear.

In applying inside cover plates the thickness has to be considered in order that the bearing value of the plate will be equal to or greater than the shearing value of the rivets, or in other words the inside plate must be strong enough to shear the outside row of rivets in case the shell plate should tear along some inner row. By reference to steel hand books we find that a 5/16 in. plate is thick enough for ¾ in. rivets, a ⅜ in. plate for ⅞ in. rivets, a 7/16 in. plate for 1 in. rivets, and a ½ in. plate for 1⅛ in. rivets. The outside cover plate should be of the same thickness as the shell plate for all outside patches, and for all patches or butt seams with inside plates which are less than triple riveted. In triple riveted seams the outside plate is sometimes slightly less than the shell plate, as the bearing area is doubled.

There are other ways in which a joint or patch may fail, such as crushing the plate in front of the rivets or crushing the rivets, but if the cover plates and rivets are of good material and of the proper thickness and diameter, there is usually a higher factor of safety than is required. In the double riveted lap seam first considered we had a total stress in the net section of 15,750 lb. Assuming the crushing value of the plate to be 88,000 lb. per sq. in., the maximum allowable working stress is 22,000 lb. per sq. in. The number of rivets in each distance p is 2 (designated by n). The total resistance to crushing will therefore be $d \times t \times n \times$ allowable crushing stress in the plate, or $0.8125 \times 0.5 \times 2 \times 22{,}000 = 17{,}875$ lb. Thus we see that the stress is 15,750 lb., while the resistance is 17,875 lb., or 2,125 lb. more than necessary for a factor of safety of 4. The resistance of the rivets to crushing may be obtained in the same manner by substituting the allowable crushing stress of the material in the rivets for the crushing stress of the plate just used.

In any boiler the stress per unit section exerted longitudinally is only half that exerted transversely, and in most cases it is safe to duplicate the circumferential seams for the ends of a patch.

Several patches and replacements, which have been applied to locomotive boilers to comply with the boiler inspection law, are shown in Figs. 3 to 5 inclusive. In each case these have been calculated to provide a minimum factor of safety of 4. Figure 3 shows a patch replacing an old one which had only an outside plate with holes very close together. This arrangement caused high tension on the net section of the plate and too great a shearing stress upon the rivets or patch bolts, and gave a low factor of safety. Figure 4 shows a difficult patch applied on the outside between two washout plug holes, to cover radial cracks around the cross brace holes. This patch being above the stayed surface had to be calculated by the radius of the roof sheet, as if it were in the shell of the boiler.

Figure 5 shows the application of a new section of roof sheet with welt strips, which were found necessary on account of the large radius, and because the seams are above the stayed surface. The two throat patches were calculated and found safe as originally applied.

FIRING UP ENGINES AT ENGINE HOUSES*

The methods outlined in the following brief description, for firing up locomotives, have given very good success in the elimination of smoke and may be readily used by nearly all roads.

When wood is used for the kindling, both sides of the firebox, the back corners and under the fire door, are filled with a layer of coal about 12 in. or 16 in. in depth, allowing the fuel to slope down toward the center of the firebox, covering it to a depth of 3 in. to 6 in. About one-eighth of a cord of wood should then be placed on the coal and the fire started by means of oily waste. The coal will then ignite very slowly, becoming coked as it burns down, and by using a forced draft the stack of the engine or the enginehouse jack will be kept clear of smoke. It has been found that a draft of 3½ in. of water is sufficient to start the fire and produce no more than No. 1 smoke. This method requires about two hours to obtain boiler pressure from a cold engine, but it may be hurried by increasing the draft and scattering coal occasionally over the bright spots in the firebox, and still give a very good smoke performance. This method is also of advantage on account of the heavy fuel bed thus formed; it is usually unnecessary to add much fuel until the engine leaves the engine house. No special grade of wood is required.

Tests have been made with various kinds of woods to determine their efficiency in kindling the fires at engine houses. Each test was hurried and it was found that the wood had very little bearing on the smoke density. Listings, bark, car wood, large wood and split ties were used in an Atlantic type locomotive, not equipped with steam jets, for each of the tests. Following is a brief description of the tests:

Test No. 1.—In this test the engine had 40 lb. of steam on when the fire was started. One-seventh of a cord of car wood was used for kindling the fire, together with 85 scoops of coal. It required 33 minutes to obtain boiler pressure. The smoke readings at the smokejack showed 14 min. of No. 1 smoke, 12 min. of No. 2 smoke, 2 min. of No. 3 smoke and for 5 min. a clear stack.

Test No. 2.—This test was started with a boiler pressure of 50 lb., and four bundles of listings were used for the kindling wood, with 90 scoops of coal. Boiler pressure was obtained in 35 min. and the smoke jack readings showed 14 min. of No. 1 smoke, 10 min. of No. 2 smoke, 3 min. of No. 3 smoke and 8 min. with a clear stack.

Test No. 3.—This test was started with 50 lb. of steam on the boiler and one-eighth of a cord of split ties was used as kindling wood, together with 90 shovels of coal. The required boiler pressure was reached in 60 min. The smoke stack readings showed 15 min. No. 1 smoke, 27 min. No. 2 smoke, 2 min. No. 3 smoke, and 16 min. clear stack.

Test No. 4.—This test was started with 65 lb. pressure in the boiler and the fire was lighted with one-eighth of a cord of bark used as kindling wood; 79 scoops of coal were used. The boiler pressure was reached in 25 min., and the smoke jack readings showed 10 min. of No. 1 smoke, 7 min. of No. 2 smoke, 2 min. of No. 3 smoke and 6 min. a clear stack.

Test No. 5.—This test was started with 65 lb. of steam on the boiler and one-fifth of a cord of large wood, consisting of car sills, beams, etc., was used for kindling, with 85 scoops of coal. The boiler pressure was reached in 25 min. and the smoke jack readings showed 16 min. of No. 1 smoke, 4 min. of No. 2 smoke and 5 min. clear stack.

As shown by these tests, the kind of kindling wood did not make any particular difference in the amount of smoke produced and the smoke obtained is attributed to the rushing of the firing up process. The most efficient kindling used was the car wood. Possibly the only advantage of certain kinds of kindling is that they may ignite quicker and the engine may thus be made ready for service in a shorter time.

To fire up an engine with crude oil the coal should be placed on the grate in the manner described above. When there is no hurry in getting up steam the crude oil torch should be operated through the fire door and focused on the part of the coal next to the tube sheet, kindling and igniting the fuel from that point back to the fire door. The torch should be held about 30 in. from the fuel, as otherwise the oil will be sprayed on the fuel, causing black smoke to be emitted from the stack. This process usually requires from 4 to 6 gal. of oil to each firebox and about 15 min. are taken to kindle a fire properly, depending, of course, upon the size of the firebox. In all methods of firing up proper supervision must be given in order to reduce the smoke to a minimum.

*From a paper presented at the ninth annual convention of the International Association for the Prevention of Smoke.

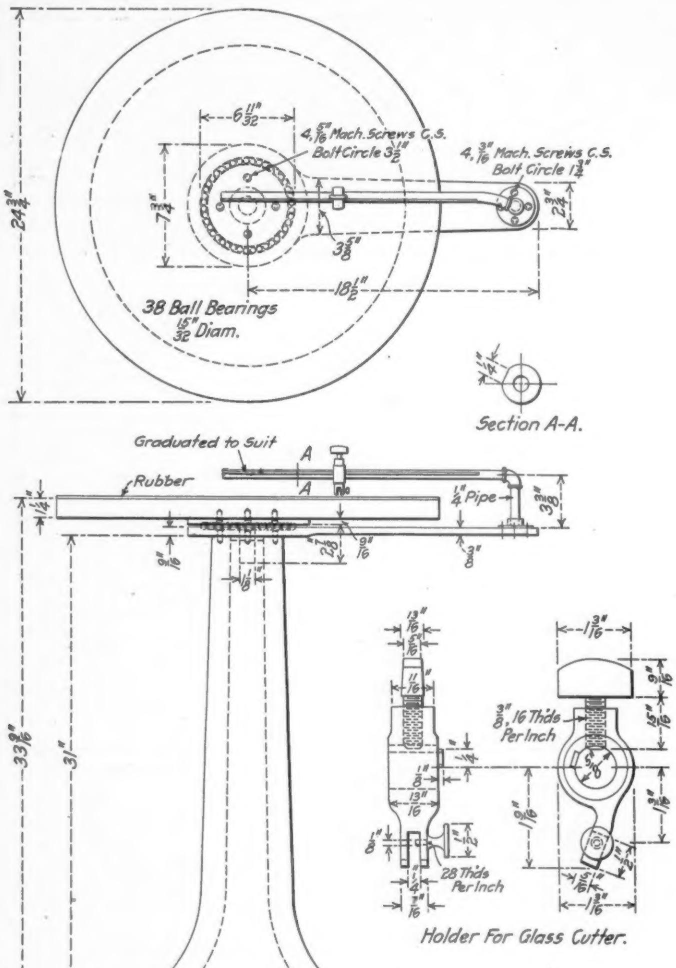
BOILER SHOP METHODS

The American Locomotive Company has developed a number of standard methods of handling the work in its boiler shops, and has had drawings and data arranged as shown in the accompanying engraving for the purpose of instructing employees in the proper methods of performing this work. These methods should prove of value to boiler shop foremen and the drawings and allied instructions will be found self-explanatory. Some of the practices outlined, particularly those connected with the lifting of various parts, will be of special interest to anyone who is following the "Safety First" movement.

Chart Showing Various Practices in American Locomotive Company's Boiler Shops

CIRCULAR GLASS CUTTER

At the convention of the Master Car and Locomotive Painters' Association held at Nashville, Tenn., last September, J. G. Keil spoke of the excellent service he had obtained from a circular glass cutter in use at the Elkhart shops of the Lake Shore & Michigan Southern. This cutter is illustrated in the accompanying drawing. It is made with a hollow cast iron base, the top of which is faced off. To this a forged steel arm is fastened by four 5/16 in. countersunk machine screws. The table is made of cast iron with a projection extending down through the forged steel arm into the hollow of the stand, and underneath the table is fastened a wrought steel plate which is fastened to it with four countersunk machine screws. A ball race is machined in both of the steel plates to receive 38 ball bearings 15/32 in. in diameter.



Arrangement and Details of Circular Glass Cutter

To the outer end of the forged steel arm is fastened another arm carrying the adjustable holder for the glass cutter, as indicated in the drawing. The cutter arm is flattened and graduated to show the radius to which the glass is to be cut. A rubber mat is used on top of the table to keep the glass from slipping, and the table is rotated by hand when the glass is being cut. Steel cutting wheels were tried, but they do not give the same satisfaction as do the diamond cutters, there being too great a loss of glass due to breakage. The diamond glass cutter if given proper care gives much more satisfaction. By the use of this machine it is possible to use up the greater part of the scrap glass which ordinarily accumulates in the paint shop, by cutting it into small diameters.

TOOL ROOM NOTES

BY A. R. DAVIS
Tool Foreman, Central of Georgia, Macon, Ga.

In manufacturing open end wrenches for use in a locomotive repair shop, in lots of 200 or less to a size, elaborate jigs are not justified for handling the work. A good practice, after drop forging and trimming the wrenches, is to grind them on the sides of the jaws on a double disc grinder, bringing them to a uniform thickness. They are then placed in the jig shown in Fig. 1 and milled out with inserted blade cutters to the nut size plus 1/32 in. This jig will take ¾ in., ⅞ in., 1 in. and 1⅛ in. wrench ends by adjusting the plates *A*, *B* and *C* to suit the outline of the wrench ends and clamping with the clamp *D* and set screws.

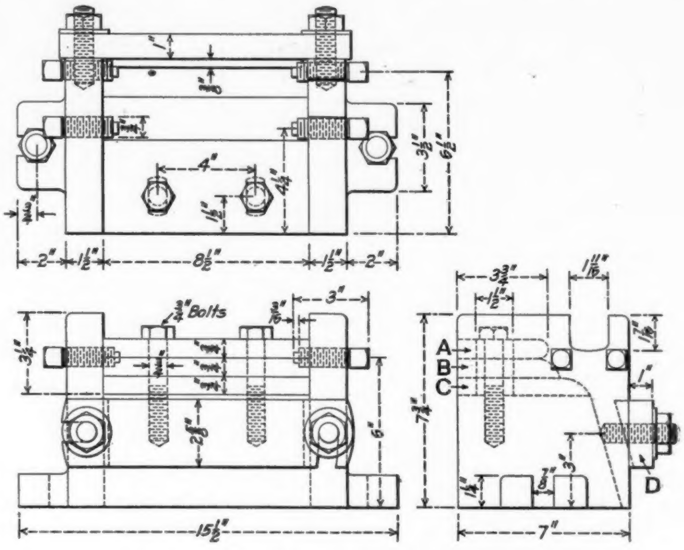


Fig. 1—Jig for Making Open End Wrenches

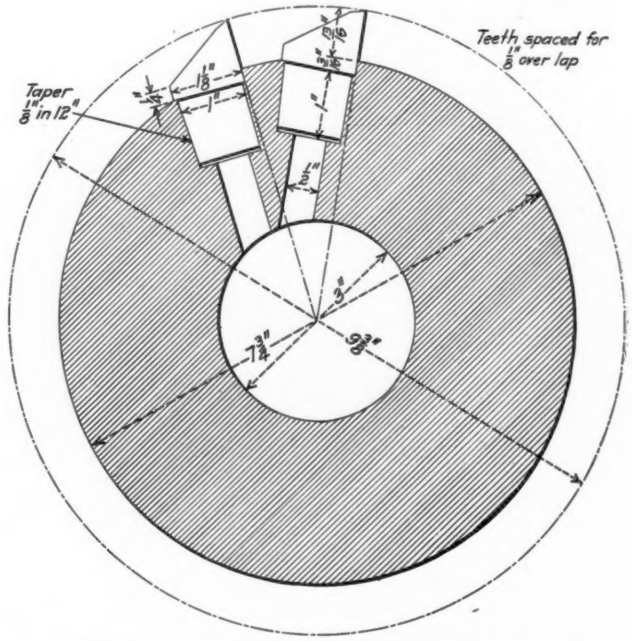


Fig. 2—Detail of Tooth Arrangement in Slabbing Mill

An efficient slabbing mill is shown in Figs. 2 and 3. This is 9⅜ in. in diameter by 23 in. face. There are 14 flutes, having an angle of lead of 20 deg. The pegs are 1⅛ in. square, overlap ¼ in. and the face is milled for three degrees rake. In

making the pegs square, the full strength of the stock is retained, whereas in the round pegs used in slab cutters over one-half of the stock is milled from the face to secure the cutting

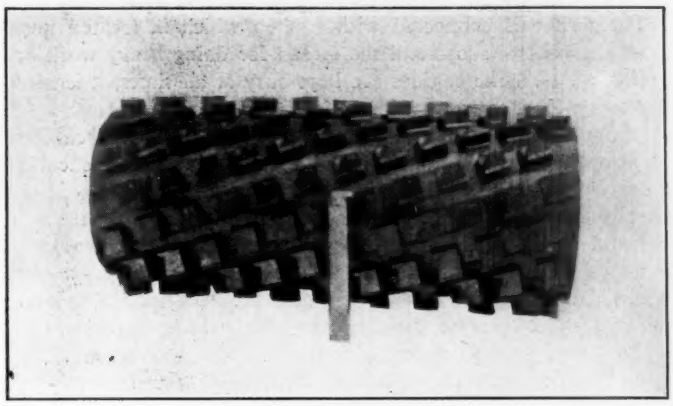


Fig. 3—Slabbing Mill Which Has Given Good Results

face. The shoulder milled for the seating of the pegs eliminates any possibility of their turning.

FORGING MACHINE DIES

A number of forging machine dies were described by J. W. McDonald, foreman blacksmith of the Pennsylvania Railroad, at Trenton, N. J., at the annual convention of the International Railroad Master Blacksmiths' Association convention, held in Milwaukee last August. Fig. 1 shows dies for making ash pan levers. This lever is made from 5/8 in. by 3 in. bar iron, on the

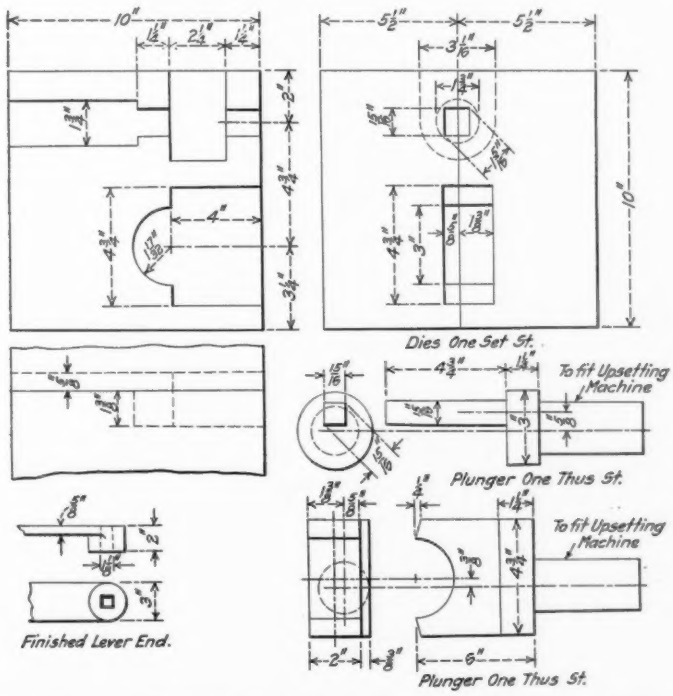


Fig. 1—Dies for Forming the Boss End of Ash Pan Levers

end of which is welded a piece of iron 1¼ in. by 3 in. by 3¼ in. with all four corners sheared off. The two pieces are placed together and heated to a high welding heat in an oil furnace. They are then upset and welded by one stroke of the forging machine. The 1⅛ in. tapered hole is made in the same heat. The hole is first punched 15/16 in. square in the same die in which it was upset and is then drifted to the required taper by a tapered pin placed on the machine instead of the shear. This work is done on a 2½ in. machine, and the finished piece is shown in Fig. 2. It makes a neat job at a low cost.

Fig. 3 represents dies used for bending brake hangers on a pneumatic bending machine provided with an 18 in. cylinder and a 30¾ in. stroke. The hanger is heated and placed on a centering block on the female die, as shown by the dotted line

Fig. 2—Ash Pan Lever Made with the Dies Shown in Fig. 1

marked "Hanger in position for bending." The head of the machine then moves forward and the hanger enters the groove in the male die. At the same instant the point of tension screw *B* has started up the angle of the wedge strip of spring steel.

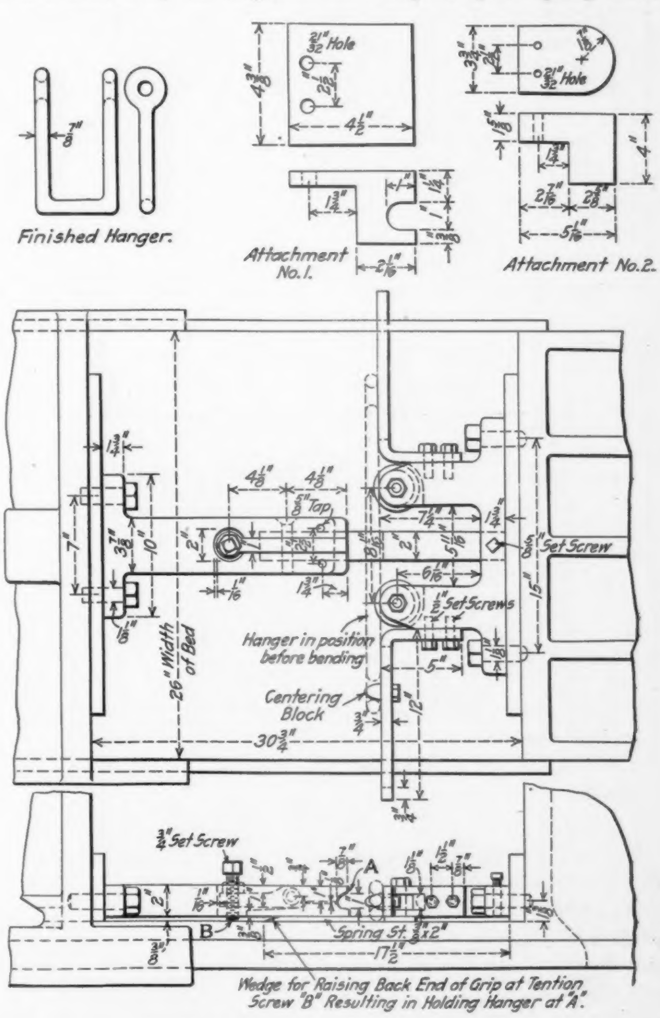


Fig. 3—Dies for Bending Brake Hangers

This causes the dog to give a vise-like grip on the hanger. The proper amount of grip necessary to hold the hanger is regulated by the tension screw *B*, it being raised or lowered to suit. With

this arrangement it is possible to have both sides of equal length, as the dog will not allow either side to drag. Another good feature of this device is that when the male die returns it carries the hanger back with it until the point of tension screw *B* drops down the angle. This releases its grip. Attachments 1 and 2, or similar pieces, may be attached to this male die for different odd jobs, which saves making a whole new male die.

Fig. 4 shows dies designed to make nut lock washers for guide bars. These dies are used on No. 6 Hilles & Jones shears, from which the shear blade heads are removed and a false holder mounted to carry the punch and bottom die. In starting in with a long strip of material the 1 7/16 in. hole is first punched. The cut, 11/16 in. deep, is then made and the last

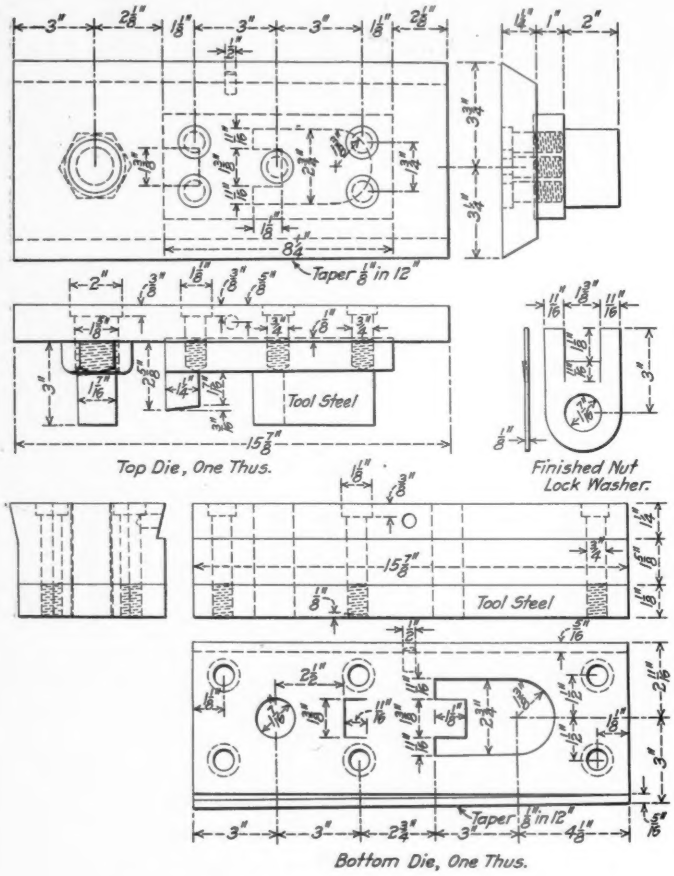


Fig. 4—Dies for Making Nut Lock Washers

operation cuts out the washer complete, as shown. After this a complete washer is turned out with every stroke of the machine, as the hole is punched two operations ahead and the 11/16 in. cuts one operation ahead, so that in the last operation a complete washer is made. Different sizes of this type of washer are made, but the dies are similar to those shown in the illustrations.

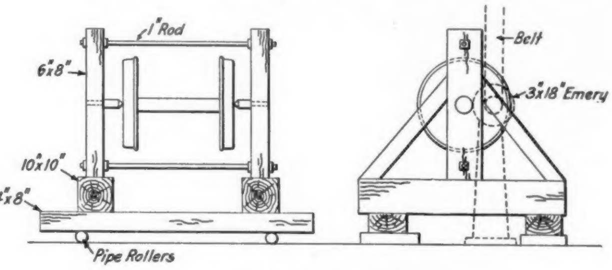
Effects of the War on Industry.—The effect of the present European war on European industry is beginning to be expressed in figures. The British Board of Trade reports that the exports for August were $100,000,000 less than for August, 1913, and that imports decreased by $65,000,000. The exportation of manufactured articles alone decreased $75,000,000. These large totals were rolled up in spite of British supremacy on the sea, which was early assured. The deplorable condition of the trade of the other warring countries can be imagined. All this is additional emphasis on the thought that America must rise to her duty of supplying the needs of the world with manufactured articles during these months of stress.—*American Machinist.*

REPAIRING A CUT JOURNAL*

BY W. M. ROBERTSON
Engine House Foreman, Illinois Central, Harahan, New Orleans, La.

The writer is connected with a shop which is located away from the general shops and the means for doing heavy work are limited. As all the engines are kept busy at all times, it is often necessary to adopt unusual means of making repairs.

In one case an engine came in with a driving journal cut, and on dropping the wheels we found that the journal was cut as much as ⅞ in. below the road limit. To make repairs in the usual way would mean taking the wheels out, loading them on a car and sending them to the main shops where they would be mounted on a new axle. This takes several days, and sometimes weeks and the engine was needed at once. We took the wheels out and by the use of the oxy-acetylene welding machine built up the metal to the original dimensions. This was accomplished by preheating with an oil burner, then using the oxy-acetylene



Apparatus Used in Turning a Cut Journal

torch and hammering the metal as it was applied. We managed to make a fairly smooth job of the welding.

Having no lathe which would swing the wheels and no press to press them off in order to do the turning in a smaller lathe, we made a frame of wood to swing them as shown in the illustration. This was then placed near the grinder and by balancing the wheels with an old driving box one man could turn them nicely. After they were started turning the frame was jacked over till the axle touched the emery wheel, which was then started, and as the frame was on pieces of pipe it was readily moved back and forth. The journal was smoothed down in this way.

The work required the service of one machinist and one helper for 30 hours. The engine has now been back in service five months and has given no trouble to date. The oxy-acetylene welder used was built complete from such material as could be found around the shop.

Production of Aluminum.—Since the beginning of the aluminum industry in 1883, when the production amounted to 83 lb., the advance has been so rapid that the production in 1913 amounted to 72,500,000 lb.—*Machinery.*

Fewer Mules in Mines.—The anthracite coal operators of Pennsylvania report that in the last decade, from 1902 to 1912, the horsepower developed at the mines increased from 354,237 to 680,700, or 326,463 horsepower; but electric power is used and the number of mules in the mines has fallen off. A good mule is now worth $240. If this 326,463 additional horsepower had been added in mules, supposing such a number obtainable, the investment since 1902 in power alone would have been nearly $80,000,000, without replacing any mules that died during that period. As a matter of fact, the number of mules decreased from 16,139 in 1902 to 15,187 in 1912. On the other hand the number of electric locomotives increased from 53 to 951, and the number of steam locomotives (on the surface) from 373 to 575.

*Entered in the competition on Engine House Work, which closed July 15, 1914.

PAINTING LOCOMOTIVES AND STEEL CARS*

BY MILTON L. SIMS†

The preparation of a steel coach for painting is of vital importance, demands the closest attention and should never be left to inexperienced help. It must be done thoroughly, as the absolute removal of all scale, grease and corrosion is necessary before any protective coatings are applied. Any idea that paint coatings will stop corrosion when it has once started, is not correct. Properly selected paint pigments, combined with the proper vehicles, will prevent the starting of corrosion.

There are several methods of removing rust from steel, such as coating the surface with oils and rubbing with steel wire brushes, emery cloth, steel scrapers, etc., but the safest and most economical for the outside of cars is the sand blast. For the interior of a steel car, I would recommend the use of raw linseed oil and benzine or gasolene, in the proportion of one part of the oil to two parts of the benzine, applied with a brush and rubbed down with emery cloth or paper.

The sheet steel used on the interior of cars is of much lighter weight and finer texture than the outside sheathing, and does not need the sand blasting. After the rubbing down is completed, the surface should be washed with gasolene and wiped dry with rags or waste, and it is then ready for the priming coat, which in all cases should be applied as soon as possible after the surface has been cleaned. This applies especially to the outside surface of the car, where the sand blasting process has been used, as corrosion will start up again in a few hours when the atmosphere is damp, and great care should be taken to prevent handling the surface with the naked hands.

We are now ready to apply the priming coat to the steel surface. This priming coat is more important than any that is to follow, except the coats of finishing varnish, and too much care cannot be exercised to see that the work is done thoroughly, brushed out evenly and every bolt head and joint coated perfectly, using suitable brushes for the purpose. This priming coat must be made from suitable pigments and carrying vehicles, finely ground and thoroughly mixed to work freely and spread smoothly under the brush, dry hard, but elastic enough to safely withstand the contraction and expansion of the steel surface, which varies greatly in different sections of the country. On the through trains running from the ice and snow of the North, to the tropical climate of the South, the change has a marked influence in producing cracking and disintegration of paint and varnish films as applied to steel cars much more than wooden cars.

When this priming coat has dried safely, the next step is to hard putty and glaze coat over all rough places, and this takes us to the second coat or brush surfacer, which is designed to fit with the priming coat. This material must also be finely ground and work and spread easily over large surfaces. It must dry hard, but elastic, and be made from selected materials. The next step is to apply a much heavier bodied surfacing material, which is then knifed off, leaving a very smooth surface, which requires very much less rubbing to bring the surface up ready to receive the color coats. The old method of using block pumice stone and water, is dispensed with, and a method employed consisting of rubbing the surface down smooth by using emery cloth, in connection with equal parts of raw linseed oil and benzine, and then washing or wiping off with rags or waste and clear benzine or gasolene. This method of surfacing does away with all danger from moisture and prevents the starting of corrosion. The oil forms a good sealer for the more or less porous surfacing material and forms a safe foundation for the succeeding color and varnish coats.

One coat of specially prepared car body color is now applied. When this is dry, a second coat is applied, which is of an elastic enamel quality, dries hard with a semi-gloss, but makes an elastic surface suitable for striping and lettering. After this, two coats of durable outside finishing varnish are applied, and the outside of the car is ready for service.

The same priming material should be used on the interior surface and followed by the second coat of brush surfacer. The heavy coat of knifing material can be dispensed with, and after the rubbing with emery cloth, oil and benzine has been finished, there follows a suitable ground work for graining in imitation of natural woods. After this, apply two coats of elastic rubbing varnish; rub to a dead finish with rubbing oil and pulverized pumice stone, or polish if desired. Where solid colors are used on head and side linings, an option is given for the use of special enamels, or quick drying elastic headlining colors to be striped and varnished over.

Canvas roofs require a specially prepared roof primer which dries very elastic and does not penetrate clear through the cotton fabric. This prevents the rotting of fabric, which is sure to occur where too much vegetable oil is used. After the special primer has been applied, special long-life roof paints are applied.

These methods are the outcome of years of careful observation of results attained by the use of methods formerly in use. Following is a schedule for painting the exterior of a steel coach:

1st day. Apply priming coat.
2nd day. Hard putty and glaze all rough and uneven parts of surface.
3rd day. Apply coat of brushing surfacer.
4th day. Apply coat of knifing surfacer.
5th day. Rub out with emery cloth, using half and half raw linseed oil and benzine, instead of block pumice stone and water.
6th day. Apply first coat of car body color.
7th day. (If Sunday), drying.
8th day. Apply second coat of car body color enamel.
9th day. Stripe and letter.
10th day. Apply first coat durable outside finishing varnish.
11th day. Drying.
12th day. Apply second coat of durable outside finishing varnish.
13th day. Car is completed.

Where shop conditions of heat and ventilation are correct, several days can be cut from this schedule, by applying the first and second coats of car body color in one day and by striping and lettering and applying the first coat of varnish in one day.

LOCOMOTIVE PAINTING

The method used in painting a locomotive, differs very slightly from that of a steel coach. The same primer and surfacing materials are used and rubbed out in the same manner, then the color coats which are usually black, are applied. For this purpose an enamel black is used on which the lettering is done and one coat of durable locomotive finishing varnish is usually applied on the water tank or tender, cab, steam dome and sand box, steam chest and cylinder casings, etc., for the best work. The enamel black should be made from selected materials which are known for their wearing and heat-resisting qualities. If the surfacing materials are made too rich with oils, blistering on the heated surfaces will often result.

Speed is demanded in locomotive painting, as each day that a locomotive is kept out of service, represents so many dollars of earning power for the railroad company. The machinists, boiler makers, pipe fitters, etc., usually get all the time and the painters get what is left, but it cannot be helped. The actual time necessary to turn out a satisfactory job, depends on shop conditions. Two and often three operations on the schedule can be carried out safely in one day. Assuming that care has been taken in removing all grease, scale and corrosion from the surface to be painted, the following schedule may be used for locomotive painting:

1st day. Apply priming coat of special locomotive primer.
2nd day. Hard putty and glaze coat all rough and uneven surfaces. (This does not apply to trucks, frame work, etc.)
3rd day. Apply brushing and knifing surfacer to water tank or tender, cab, steam dome, sand box, etc.
4th day. Rub out surface with emery cloth, using half and half raw linseed oil and benzine. Wipe off dry with rags or waste and clear

*From a paper read at the meeting of the Central Railway Club, Buffalo, N. Y., November 13, 1914.
†Special representative, Sherwin-Williams Company, Cleveland, Ohio.

benzine, being careful not to use too much benzine. Follow up with coat of black enamel. On the best work a coat of flat black is applied over all the surface, except the trucks, frames, etc., before the black enamel coat is applied.

5th day. Letter and varnish with a coat of durable locomotive finishing varnish.

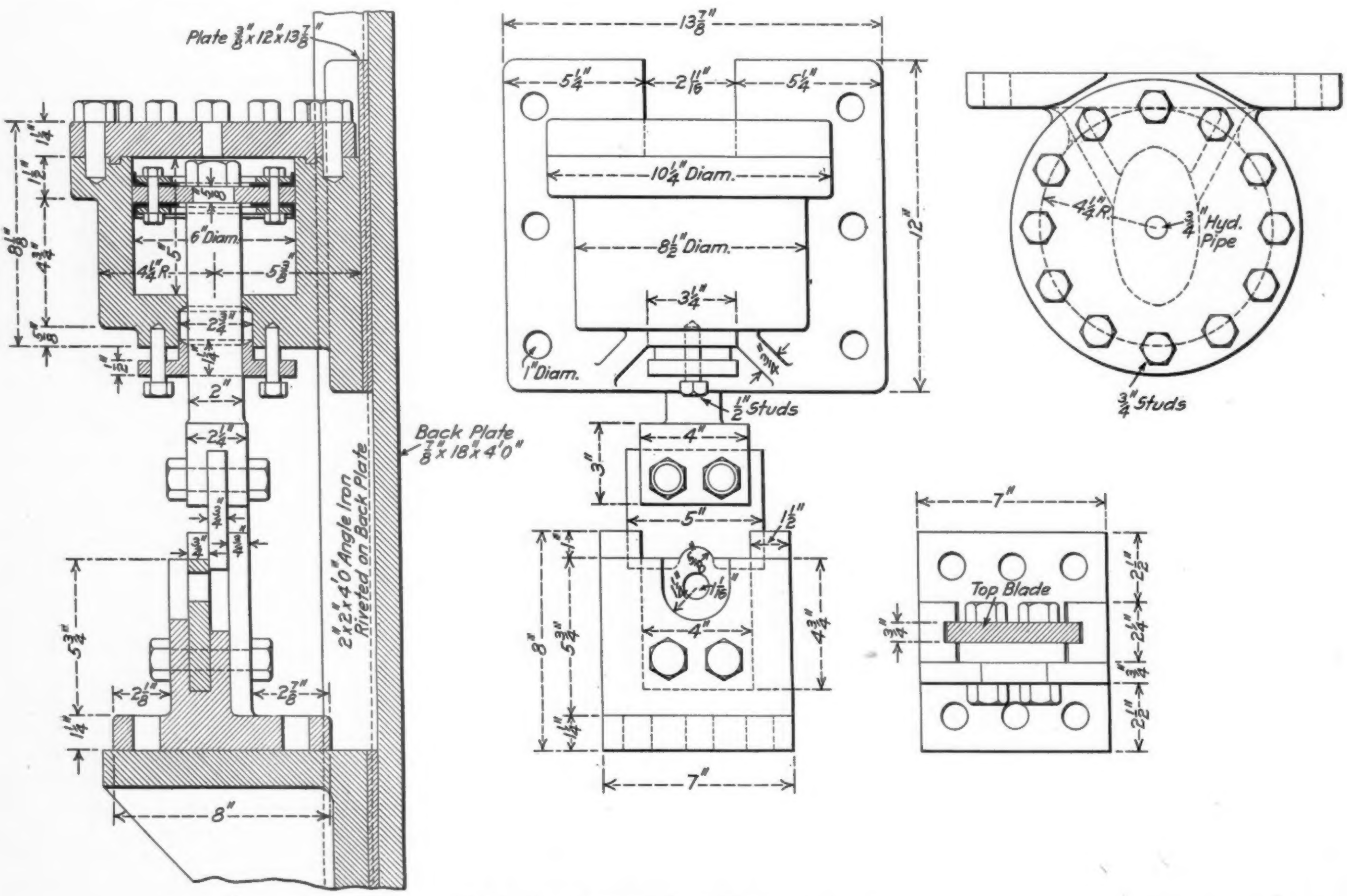
PAINTING STEEL FREIGHT CARS

The method of painting steel coal cars has changed very materially in the last few years. Formerly all coatings were made very elastic and very little attention was given to making the first or priming coat dry differently from the last or finishing. Research work on this matter has proved that the method was wrong and that the first or priming coat should be constructed so as to dry hard and elastic, using specially treated vehicles for the purpose and such pigments as will be neutral and last the longest. The finishing coats are made more elastic and have more gloss and moisture-resisting qualities. The reason for the priming coat being made to dry harder and with less gloss, is that coal cars are subjected to rough usage while being loaded and unloaded. Large lumps of coal striking the sides of the cars glancing blows soon knock off much of the painted surface when the elastic coatings are new.

SHORT RIVET SHEAR

BY E. T. SPIDY
Assistant General Foreman, Canadian Pacific, Winnipeg, Man.

Very often rivets and patch bolts are required shorter than the standard lengths carried, and it becomes necessary to use some standard length and cut it down to the length required.



Shear for Cutting Short Rivets and Bolts

The drawing shows a small hydraulic sheer designed for shearing rivets and patch bolts up to 1 1/8 in. in diameter. Few boiler shops are satisfactorily equipped with facilities for this work; it is generally done on the ordinary shear, and is an awkward and unsatisfactory job, or else the rivets are taken to the bolt shop where a certain amount of waiting is inevitable. This shearing machine is small and inexpensive, and has a cylinder 6 in. in diameter and 2 1/2 in. in stroke. It is placed on the wall of the shop at a point where it can be conveniently connected to a hydraulic main carrying a pressure of 1,500 lb. per sq. in. It is so arranged as to give positive action in both directions. The bottom blade is bolted to a casting which acts as a guide for the top blade. The blades are only 3/4 in. thick and the front of the guide casting is recessed around the hole in the bottom blade so that rivets or patch bolts can be cut as short as 3/4 in. with safety and ease. The guide and bottom blade casting are bolted to an angle block which, together with the cylinder, is bolted to a 7/8 in. plate stiffened with two angles to resist buckling action and bolted through the wall of the shop.

EFFICIENCY IN A MODERN ENGINE HOUSE*

BY JOHN C. MURDOCK†

In any engine house where the larger types of locomotives are handled the equipment is the chief issue in regard to the cheap handling of the work. For the handling of modern locomotives, a modern engine house is imperative. Ash pit equipment and water plugs should be so located that engines may be handled quickly on arrival at the terminal so as to allow for the greatest amount of time for repairs and for proper care before the engine is required for service again.

A well equipped machine shop and a drop pit are also necessities, if high mileage is to be assured between general repairs. The machine shop should be such that heavy engine house re-

*Entered in the competition on Engine House Work, which closed July 15, 1914.

†39 Allston street, Allston, Mass.

pairs, such as renewal of tubes, changing wheels, etc., can be made on several engines at once. This furnishes enough work to take care of the varying conditions of engine house work. Some assigning of certain work to certain men is essential, but it is possible to overdo this.

Inspection is one of the most important features. Two good engine inspectors, one working under the engine and one outside, can inspect and do many small jobs on 35 to 40 engines, with one man working 9 hours and the other 12 hours for the day force, and the same for the night, giving the service of one man throughout the 24 hours on engine inspection. There should also be two men on air brake inspection in the same way, day and night. This means working inspection; the men see all they can and do all they can and do not, with pencil and paper, search for work for some one else to do. Another important matter is to have a man trained to set engines so that he can set up the wedges and key the rods, and keep the knuckle pins and wrist pins tight. He should also put in new guide bolts and cross-head shoe bolts when they are required.

Another classified job should be the grates and front end work so as to have the rough work taken off the higher paid mechanic and at the same time have a man trained to do this work quickly and well. This job should not be made too cheap. A pipefitter should also be trained for engine house work; he should do all the steam heat and piping work, cab work, gage cocks, etc. This puts most of the piping outside of the air brake gang all in one man's hands and in this way he may have the tools and experience to handle the work with speed, while at the same time it relieves the other men of the care of piping tools.

Air brake work should be handled separately from the other machinist's work. There should be one man to do the oiling, one on the grease cups and one on the headlights and markers. Special men should be trained to blow out the tubes and take down arches, and also to prepare engines, for the boilermakers. The latter will cool down the engines when required and connect the blowers so that the engines may be put in condition for the men to work on them. The regular machinist force should be so trained that while special jobs are assigned to individual men, as they show more aptitude at certain work, they should be overlapped to cover all lines of engine house work. The idea of one man having a busy day one day and a slack one the next is poor policy; let them all have a busy day or a slack day together.

Work slips should be turned in every day and carried over from shift to shift; in case of an engine being used again with work not done they should be turned in so marked. On investigation, if this work seems important and its neglect has a bad effect on the engine, steps must be taken to have it done.

A book should be kept with the dates of washout and the cleaning of tubes and arches, and enginemen given to understand that there are certain dates when the engines are dumped; that they will not be blown off to pack throttles and grind gage cocks at such times as the engineman picks out, but that he will have to conform to this system. If enginemen are in the habit of leaving their engines at night with a small work report or none at all, and then coming around in the morning and requiring part of the engine house force to wait on them, they should be told to make out work slips on their next trip showing what is wanted.

Avoid doing duplicate work or unnecessary work just because somebody wants to be satisfied. Do not reduce front end brasses so that they turn the wrist pins in the crossheads, or close in main pin brasses so that they run hot, or set up wedges until they stick; keep the wedges parallel, brasses keyed brass and brass, guides closed and pedestals tight, and if the main wheels need to be dropped, do it when it is thought they need it, after an examination and a conference with the road foreman of engines.

Responsibility for the care of the power should reach from the lowest paid man up to the master mechanic if the system is right and a system should be employed, no matter how poor it may seem at the start. The engine despatcher and general foreman should co-operate in every way. A board should be kept showing all engines to be despatched and their leaving time, and another board for the use of the men in marking off the work as it is done.

The master mechanic should keep in touch with his foremen and know what is needed as to tools, etc., and he should use his influence with the higher officers to obtain them.

PAINTING STEEL CAR DOORS

At the recent Master Car and Locomotive Painters' convention at Nashville, Tenn., C. A. Cook, master painter of the Philadelphia, Baltimore & Washington, Wilmington, Del., mentioned

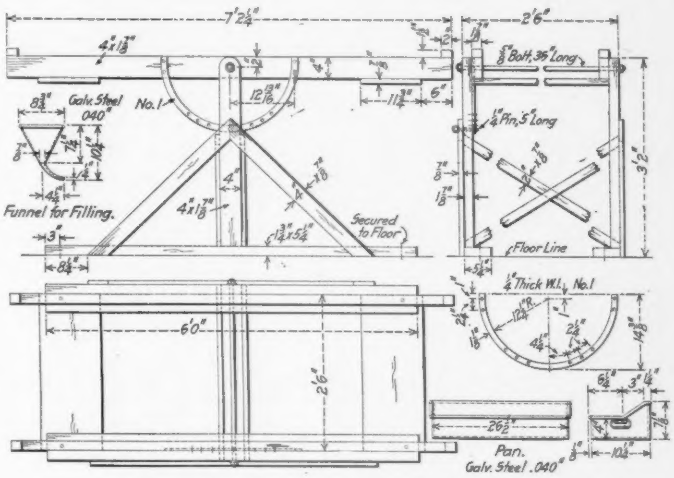


Fig. 1—Adjustable Rack for Slushing Steel Doors

two shop kinks that were especially valuable in painting steel car doors. These are shown in the accompanying illustrations. Fig. 1 illustrates an adjustable rack equipped with a pan and

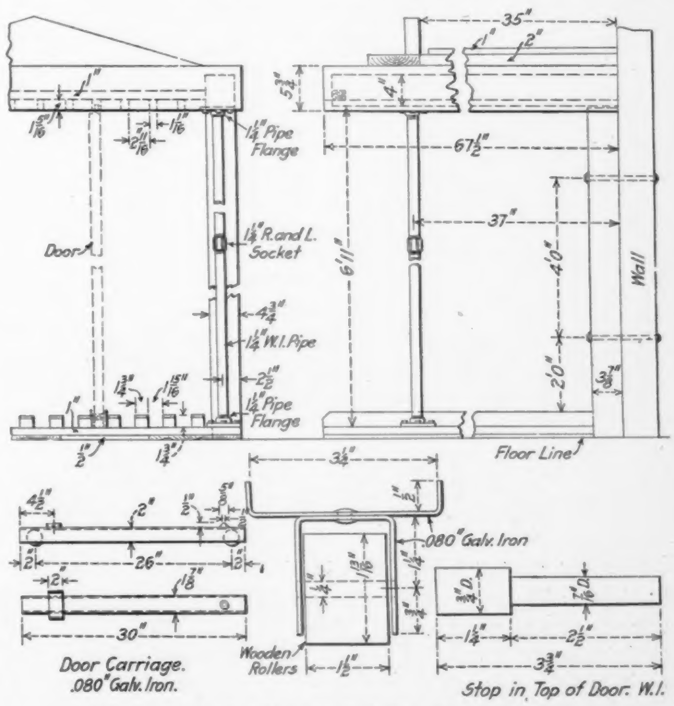


Fig. 2—Rack for Use in Painting Steel Car Doors

funnel and used in connection with slushing the interior of the doors of steel car equipment. The door is placed on the rack and turned at the desired angle, the paint being poured in

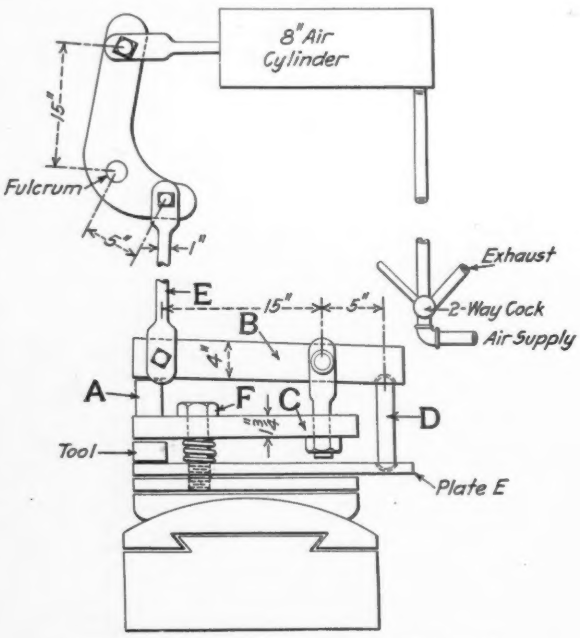
through holes in the end. The table is then reversed and emptied, the inside of the door in this way being completely covered. Its simple construction is readily indicated by the drawings, and it is made almost entirely of wood. A wrought iron quadrant ¼ in. thick fitted with pin holes is used to hold the table in its inclined position. A galvanized steel funnel with a bent outlet, as shown is used for pouring the paint into the doors.

Fig. 2 shows a door rack which has proved very efficient and economical. It does away with the repeated handling of the heavy steel doors, as, after being placed on the carriage the door is not again handled, except to be pulled forward from the rack for each paint operation and then pushed back to dry. It can readily be seen that a large number of doors can be handled within a comparatively small space. From the construction it will be noted that the carriage on which the door is placed is 30 to 36 in. long, the wheels being nearly 2 in. in diameter. This permits of moving the doors in and out of the rack readily. A stop is placed in the top of the door, as shown, to keep it in a vertical position while in the rack. The rack is made principally of wood, with 1¼ in. wrought iron pipe supports.

TOOL CLAMP FOR WHEEL LATHES

BY R. F. CALVERT

A tool clamping device in use on an old style car wheel lathe at the Horton, Kan., shop of the Chicago, Rock Island & Pacific is shown in the illustration. The 8 in. air brake cylinder is fastened to the ceiling above the machine. Air is admitted to the back end of this cylinder, thereby driving the piston forward, which raises the end of the bar *B* by means of the lever and connecting rod *E*, this in turn tending to raise the opposite end of bar *C*. The other end of bar *C* presses down on the tool and securely clamps it. When the full amount of air has been admitted and the full compression has been gained on the tool, the block *A* is inserted between the bars *B* and *C*. It will be noted that the space between these two bars will, when in tension, be slightly tapering. The block *A* is, therefore, placed as far back as it will go and the air is exhausted from the cylinder. It is found that a block placed in this way will hold the tool in place.



Pneumatic Clamp for Wheel Lathe Tools

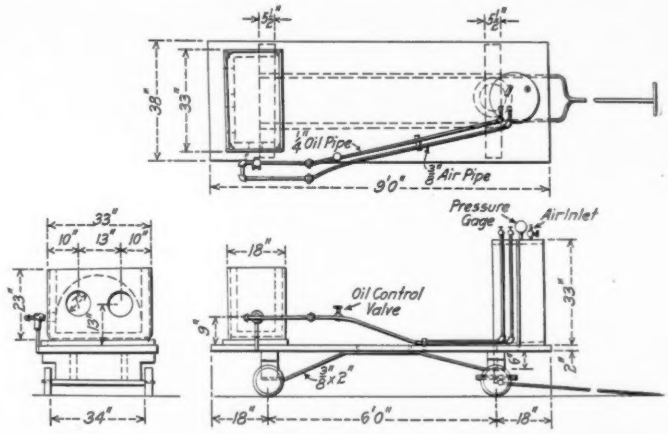
The part *D* is a round steel bar 1½ in. in diameter, with rounded ends which fit into sockets in plate *E* and bar *B*. The bolt *F* is one of the original clamping bolts, around which is placed a steel spring to hold bar *C* in place when the tool is not in use. The cylinder lever is arranged as shown in order to avoid the necessity of packing the piston rod.

RECLAIMING CAR AXLES

BY ROBERT W. ROGERS
Instructor of Apprentices, Erie Railroad, Port Jervis, N. Y.

A material saving in the cost of car axle renewals may be effected by upsetting worn axles and refinishing them to the next smaller size. An axle having 5½ in. by 10 in. journals may be upset 1 in. on each end and refinished into a new axle having 5 in. by 9 in. journals, 4¼ in. by 8 in. axles being secured in the same way from worn 5 in. by 9 in. axles.

The special equipment required for doing this work consists of a portable furnace, a small roller table upon which the axles are supported while being heated and an inclined table by which they are handled to a wheel press, where the upsetting is done. The furnace is shown in detail in the accompanying drawing. It is made up of ½ in. boiler plate lined with fire brick, the top being arched with fire clay as shown in the drawing. The furnace rests upon one end of a four-wheel truck from which it is insulated by 1½ in. of asbestos lagging. Upon the other end of the truck is placed an oil tank which is piped to a burner located in front of an opening in one side of the furnace. A simple burner built up of a globe valve body and pipe reducers is used. Two 7 in. holes through the wall of the furnace facing the end



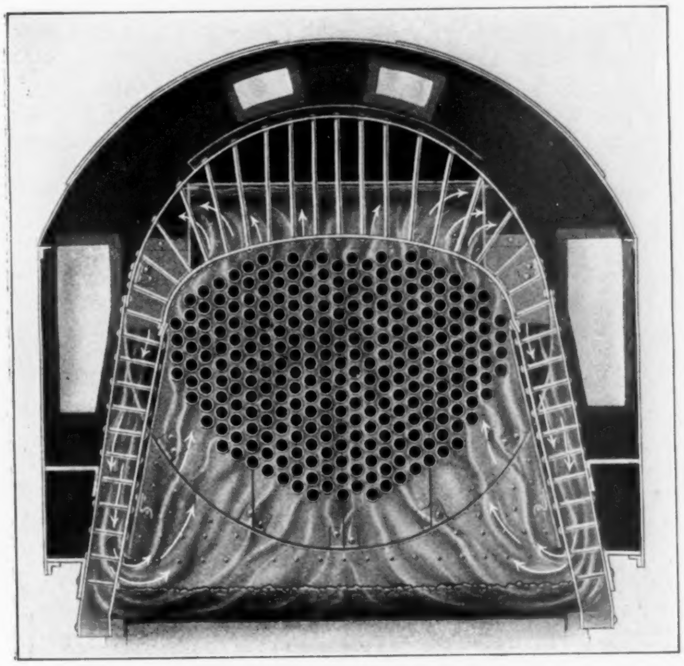
Furnace Used in Reclaiming Car Axles

of the truck are provided for the insertion of the axle. A roller table 31 in. wide by 48 in. long, the frame of which is built up of 2 in. angles is placed in front of the furnace. Two axles at a time are placed upon the table and the ends inserted in the furnace about half the length of the journal. Handling of the axles into and out of the furnace is facilitated by rollers in the top of the table. When the ends of the journals have been brought to a white heat for a length of about 4 or 5 in., they are drawn out of the furnace and rolled down the inclined table to the wheel press where they are handled into the wheel press by an air hoist. The upsetting is done by placing the heated end of the axle against the tailstock of the wheel press and running the ram against the cold end until the proper reduction in length has been made. By this process the end of the journal is upset sufficiently to form a collar for the new journal and it is necessary to remove about ½ in. of stock in finishing up the journal bearing. The labor of two men is required to supply axles to the furnace and to take them from the furnace to the wheel press. In a shop where a hydraulic press is available the total cost per axle for upsetting, including all labor and fuel, is 35 cents. As the average cost for new axles from 6 in. by 11 in. to 4¼ in. by 8 in. is about $12.50 each, and the scrap value of worn axles at ½ cent per pound is about $4 each, a saving of about $8.15 is effected for each axle reclaimed ready for turning.

NEW DEVICES

CIRCULATING SYSTEM FOR LOCOMOTIVE BOILERS

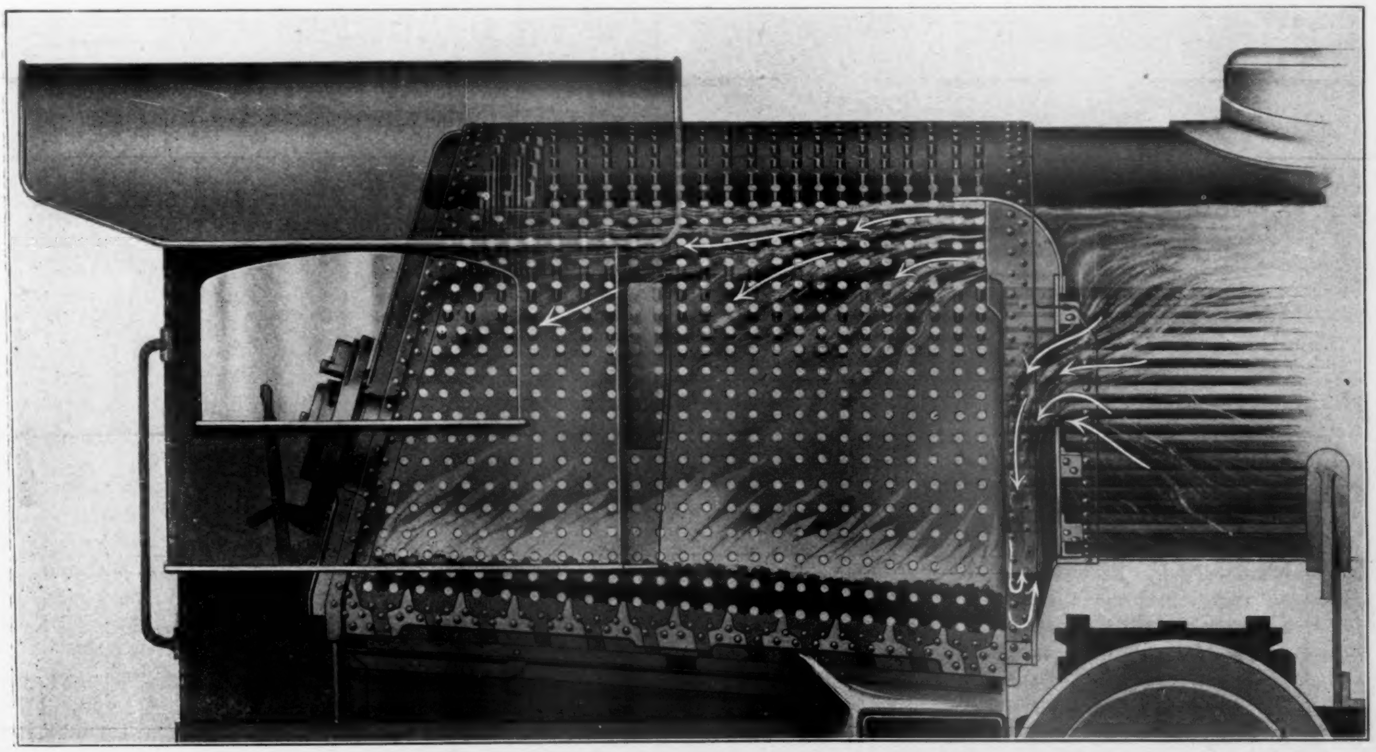
A device for applying the Ross-Schofield system of circulation to locomotive boilers is being introduced by the Q & C Company, 90 West street, New York. The Ross-Schofield system of circulation was developed and has been in successful use for some time in marine and stationary service. In this system the circulation is produced by utilizing the force resulting from the separation of the steam from the water. A space is confined about the hottest portion of the heating surface by means of baffle plates, communication with the body of water in the boiler being provided at the top and bottom only. The generation of steam within the water column thus formed produces a rapid upward circulation of the water, provision being made at the surface of the water to properly guide the current thus formed.



End Elevation, Showing the Direction of Flow from the Barrel of the Boiler

The device as applied to locomotives is made up of three parts. A baffle plate which loosely surrounds the tube and separates the barrel of the boiler from the firebox portion is secured to the shell of the boiler at the throat sheet. This extends to a height level with the highest point of the crown sheet, and openings are provided at the sides below the center line of the boiler. The space between the baffle plate and the firebox side sheet is closed by side plates which extend downward to a point about 10 in. above the mud ring. A water column is thus formed which is enclosed by the flue sheet, the baffle plate and the two side plates. All circulation from the barrel of the boiler must pass through the openings in the baffle plate, downward through the water leg to the bottom of the side plates and thence upward over the rear flue sheet and the rear ends of the tubes. Supported to the top of the baffle plate is a curved hood extending up to the normal water line, which directs the circulation over the crown sheet toward the back of the firebox. The water about the firebox thus moves in a circuit; upward across the flue sheet, backward and downward along the crown sheets, side sheet and door sheet, and forward near the bottom of the water legs. As the water in the firebox space is evaporated, more flows in from the barrel of the boiler through the openings in the baffle plate.

Among the advantages which are claimed for this device is increased rapidity of evaporation due to the constant freeing of the heating surface from the steam bubbles by the sweeping ac-



Phantom View of the Ross-Schofield System of Circulation, Showing the Direction of Currents Over the Crown Sheet

tion of the water. Priming which is caused by the violent separation of the steam from the water is overcome by means of the hood which directs the rush of the rising steam and water in a horizontal direction, thus making available the entire surface of the water over the crown sheet for the separation of steam with a consequent decrease in violence of ebullition at any one point. The rapid circulation of the water prevents the formation of stagnant pockets of cold water near the corners of the firebox and produces a uniform temperature at all points around the firebox, thus in a measure reducing the effects of unequal expansion and contraction. It is also claimed that the formation of scale is largely prevented by the rapidity of the circulation, which causes the particles of scale-forming material to collect at the mud ring, where they may be disposed of through the blow-off cock. This is borne out by the result of experience with the system in stationary service.

This device may be readily applied to old boilers whenever the tubes are removed for repairs. The baffle plates may be made in sections of any size suitable to be taken into the boiler through the dome, the parts being assembled inside the boiler before the tubes are applied.

SAFETY BAGGAGE RACK

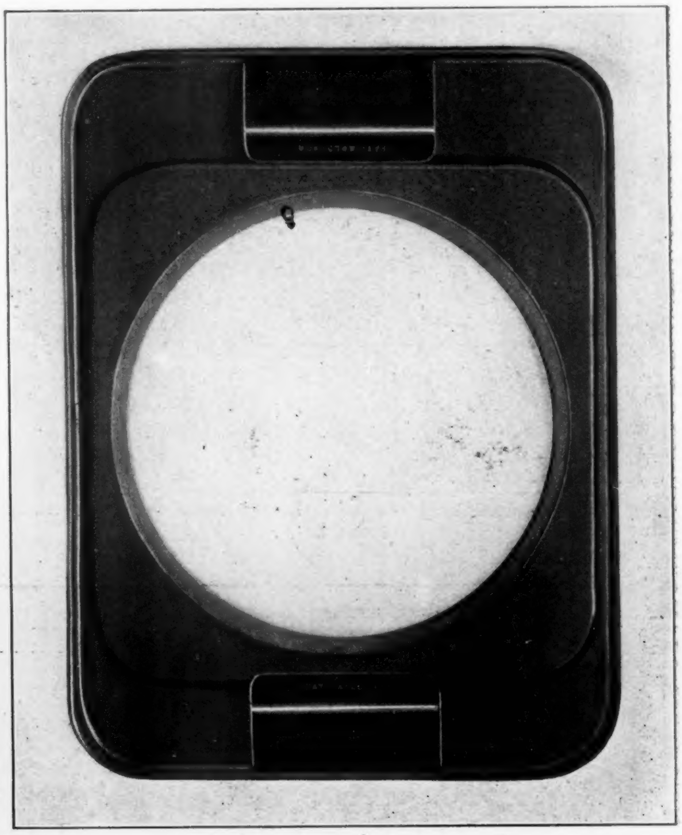
The Atchison, Topeka & Santa Fe has placed in service on some of its through passenger train cars a new type of baggage rack designed by the engineer of car construction. These racks were designed to provide ample storage capacity. They are provided with gates which slide on the frame of the rack and serve to keep the bags, parcels, wraps, or whatever may be placed in the rack, in place. The illustration shows the racks installed in one of the day coaches recently built by the Santa Fe, and also shows the way in which the gates are operated by the passengers. There are two gates to each rack, so arranged that each may be operated independently of the other. The racks are of special advantage, especially on through trains where a considerable amount of hand baggage is often carried by the passengers, in that they will hold more than the ordinary rack now used, and at the same time prevent the luggage from falling on the heads of the passengers. In this way it eliminates damage claims from these causes and provides sufficient capacity to hold all the baggage of the passengers, thus keeping the aisles free from obstruction. The construction is so substantial that the gates will slide easily when the rack is loaded to its full capacity.

Safety Baggage Rack in Santa Fe Coaches

JOURNAL BOX DUST GUARD

The illustrations show a built up dust guard which has recently been introduced by the National Railway Equipment Company, Toledo, Ohio. It is constructed of pressed steel and hard vulcanized fiber; it has a total thickness of about ½ in. and is easily inserted in any dust guard compartment. The design is such that it adjusts itself automatically to the movements of the axle while effectively closing the journal box.

The body of the guard is made up of three parts. A movable center of fiber is enclosed in a rectangular pocket formed in a sheet steel case. This pocket is of the same thickness, but otherwise slightly larger than the movable center, thus allowing for adjustment of the fiber center without movement of the case. The edges of the two halves of the case are turned up at a sharp angle and between them is inserted a strip of wool felt which is pressed firmly against the side of the dust guard compartment when the guard is in place. This prevents the loss of oil or the ingress of dust between the guard and the box. The fiber center is about ¼ in. thick, and is so constructed as to allow an expansion of 1/16 in. in the diameter of the axle fit, thus insuring ease of insertion upon the axle. The form of the steel case provides ample strength and rigidity, and it is protected by a permanent rust inhibitive coating. Spring clamps are secured to both the top and bottom on the back side of the case. When in place these firmly press the guards against the side of the compartment and maintain a tight joint around the front face of the guard. They are of sufficient strength to hold it in any desired position, relieving the journal of all unnecessary weight and preventing the rapid wear of the fiber center.



Steel Dust Guard with Adjustable Vulcanized Fiber Center

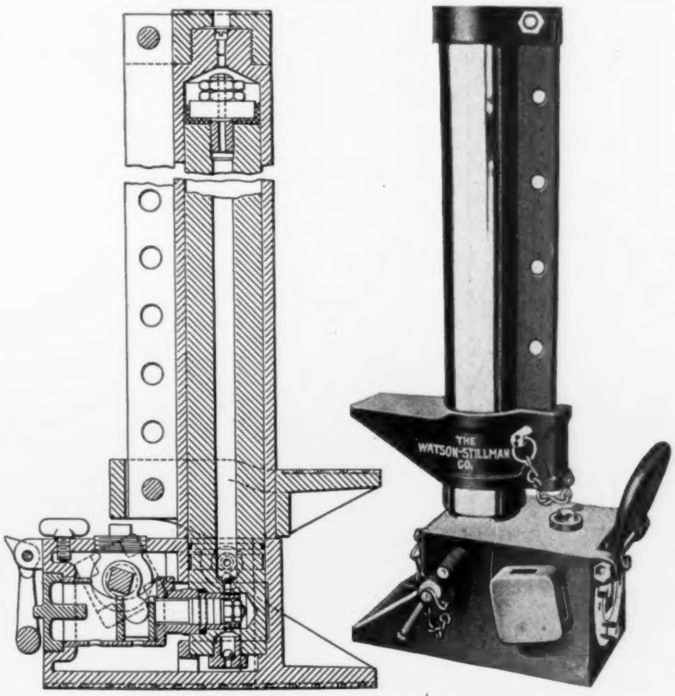
This device has been patented, and is now being tested on a number of railroads. Its simplicity makes it practically unbreakable in service, and its efficiency does not depend upon outside conditions. No plug or stopper is required to close the top of the dust guard compartment because communication with the body of the journal box is closed by the guard itself.

EMERGENCY JACK

A hydraulic jack, the design of which embodies a number of unusual features, has recently been developed by the Watson-Stillman Company, New York. This jack was designed primarily to meet the demands of an emergency jack for street railway use, but its flexibility of adjustment is such as to make it of value for a variety of purposes wherever lifting work is performed.

The construction of the jack is shown in the sectional elevations, from which it will be seen that the cylinder is the moving part instead of the ram as in the usual type of jack. This allows the pump mechanism to stay in a fixed vertical position and permits the working parts of the jack to be made simpler and more compact than is usually the case. The piston is packed with leather rings and the valves are of the ball type with all passages amply proportioned. The pressure is relieved by means of a key operating a small needle valve. The jack is operated with a special oil, which not only acts as a lubricant, but prevents rust on the working parts and the possibility of freezing. It has no detrimental effect on the packings.

One of the most notable features of this jack is the arrangement of the claw which can be moved vertically upon the cylinder and adjusted to the most convenient height. The claw and the cylinder can be swung through a complete circle without changing the position of the jack or the location of the pump. The operating lever is but 18 in. long, but one man weighing 125 lb. can obtain the maximum pressure with but slight effort. The lever is curved and the socket has a hole in each of its four sides to allow for convenience in operation from practically any position. The jacks are now built in five and ten ton sizes with a ram stroke of 10 in., and are guaranteed by the manufacturer to stand a 50 per cent overload without detriment to any of the parts.

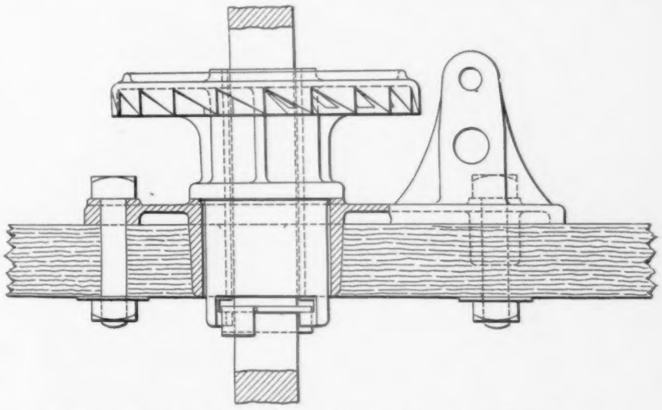


Exterior and Sectional Views of Emergency Jack

Endurance Tests for Automobiles.—Endurance tests for automobiles, the prizes for which are to be orders for winning cars, have been held by the Russian army authorities. The first prize will be an order for 250 cars, the second, an order for 150 cars, the third, for 100 cars, and the fourth, an order for 50 cars.—*Machinery.*

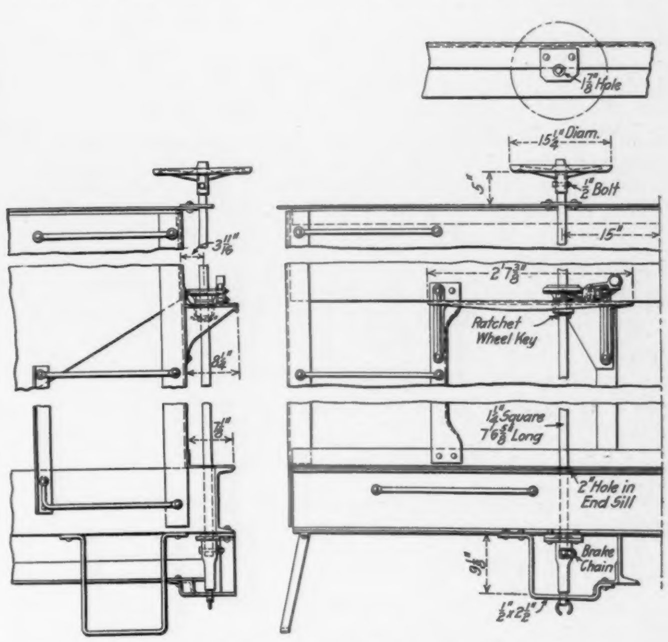
SQUARE BRAKE SHAFT

Before the safety appliance law went into effect it was the practice of many railroads when manufacturing brake shafts to weld the enlarged chain drum end to the shaft proper, and for repairs, especially at points remote from the principal shops, the practice of welding was almost universally followed. Some railroads which were well equipped with forging and upsetting machines had practiced forming the shafts by upsetting in place of welding; in consequence their cars more nearly meet the requirements of the law in this particular, and they find less difficulty in complying with it than do roads not so fortunately equipped. The manufacture of solid forged brake shafts for thousands of cars, together with the demand for handholds, ladder rounds, etc., is a severe tax on the capacity of railroad blacksmith shops.



Section Showing Pawl Plate Used on Wooden Brake Steps

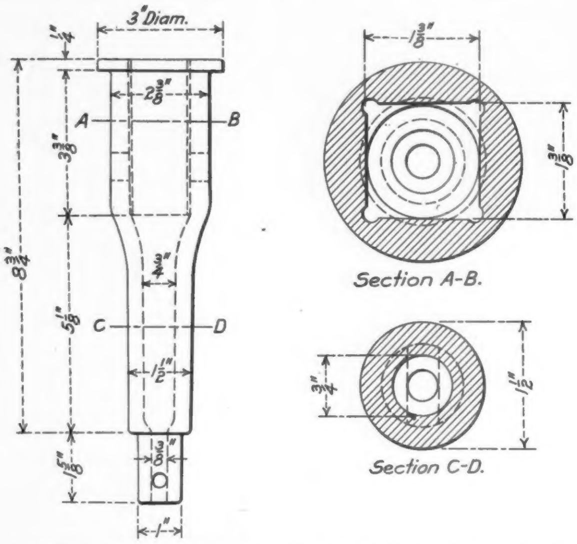
When the safety appliance standards of the Interstate Commerce Commission went into effect, the Buffalo, Rochester & Pittsburgh was one of the many roads which found that a large number of its cars had welded brake shafts. The complement of forging machines which had been sufficient for ordinary conditions was found insufficient to turn out the requisite number of handholds and brake shafts, and it became necessary either to invest in expensive forging machines and furnaces or to design a brake shaft which dispensed with the upsetting process. The design illustrated was finally developed, by which the upsetting process, the forging down of the ends of the shaft, and thread-



Square Brake Shaft Applied to Gondola Car

ing the end for the brake wheel nut, are dispensed with, while the ratchet wheel is secured to the shaft without the use of the troublesome key-way and taper key. One of the engravings shows the brake shaft applied to a steel hopper car with a cast metal brake step. A similar arrangement is used on box cars, this type of brake step making the use of an independent pawl plate unnecessary. For gondola cars wooden steps are used and a special metal pawl plate is required. This is provided with a bearing for the ratchet wheel hub and is cast with integral lugs for the support of the pawl.

The brake shaft is a plain square bar of iron or steel, without



Malleable Iron Chain Drum for Square Brake Shaft

forge manipulation of any character, two bolts holes only being required, one near each end; the one at the lower end serves to engage the brake shaft drum and to secure the brake chain, while that near the upper end engages the brake wheel. The brake drum is made in two diameters, the upper and larger portion serving as a quick take-up for the slack of the brake chain, and when actual tightening of the brake takes place the chain is on the smaller diameter so that the efficiency of the brake is not impaired. The lower end of the drum casting is reduced in diameter where it passes through the stirrup and is held in position by means of a ring key in a 3/8 in. drilled hole.

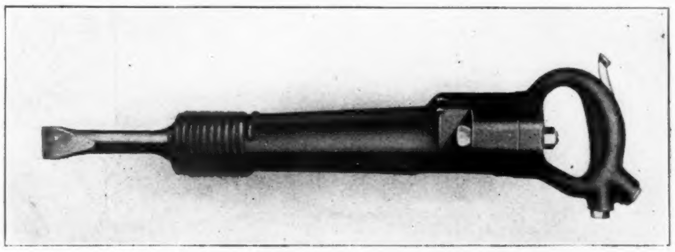
The hand wheel is cast with a long hub extending below the wheel. In this hub is a square hole with parallel sides to fit the square brake shaft. A bolt through the hub and the shaft serves to secure the wheel to the shaft. In order that one pattern may be used for both square and round shafts a short extension of the hub above the wheel contains a square taper socket for use on the usual type of brake shaft.

The ratchet wheel is formed with an extended bearing or hub below the toothed disc. This bearing extends through the opening provided in the brake step or brake pawl plate and a flat plate key is inserted in the groove cast in the end of the hub to prevent the removal of the ratchet wheel from the brake step when once placed in position. In assembling the parts upon the car the ratchet wheel is placed in position in the brake step before the shaft is inserted, there being no connection between the shaft and the wheel. This is also true of the intermediate bearing and support used on the ends of box cars. Applying or removing the bolt through the drum secures or permits the removal of the brake staff. As shown in the drawings, the ratchet wheel has the teeth on the lower face and operates with a gravity pawl. The same type of construction may be readily used with a ratchet having radial teeth.

In assembling and applying the shafts to the cars no skilled labor is required. The castings are applied in the rough, and aside from the drilling of holes for the bolts and the stirrup key, no machine work is required. The arrangement has been patented by F. J. Harrison, superintendent of motive power, and W. J. Knox, mechanical engineer of the Buffalo, Rochester & Pittsburgh, on which road it has proven very satisfactory in service upon a large number of cars.

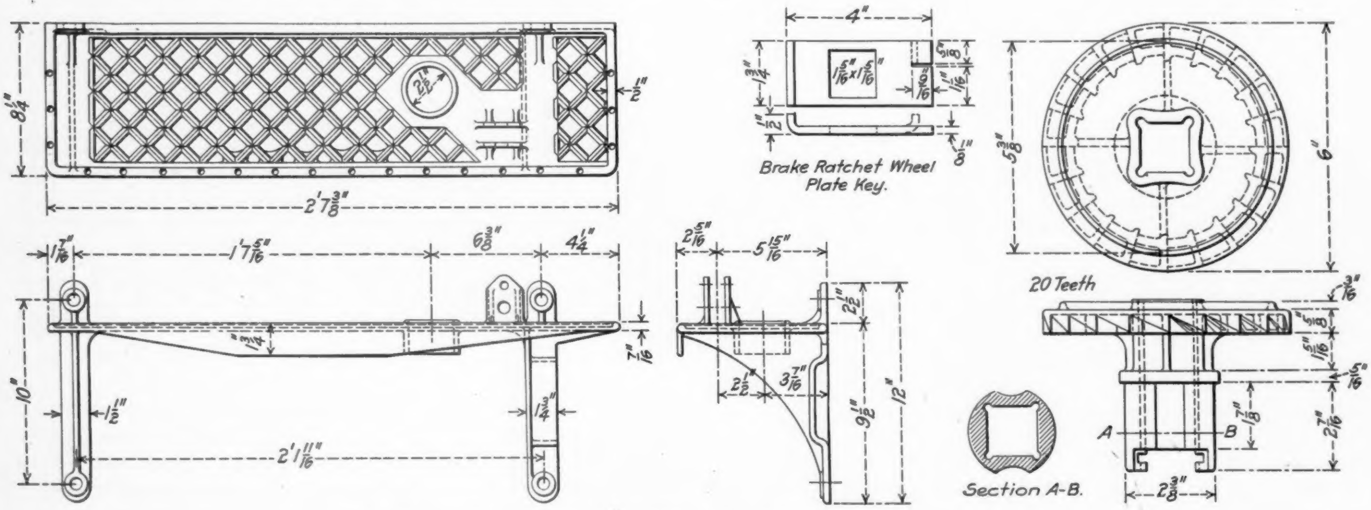
RIVET BUSTER

While assembling structural members in the field and in boiler shop work it is often necessary to remove rivets after they have



Rivet Buster for Use in Pneumatic Riveting Hammer

been driven, because of improper workmanship or to permit of some modification in construction. Pneumatic chipping hammers are probably the handiest tools for use where a large number of rivet heads must be removed. Where this work is required only occasionally, however, it is inconvenient to keep a

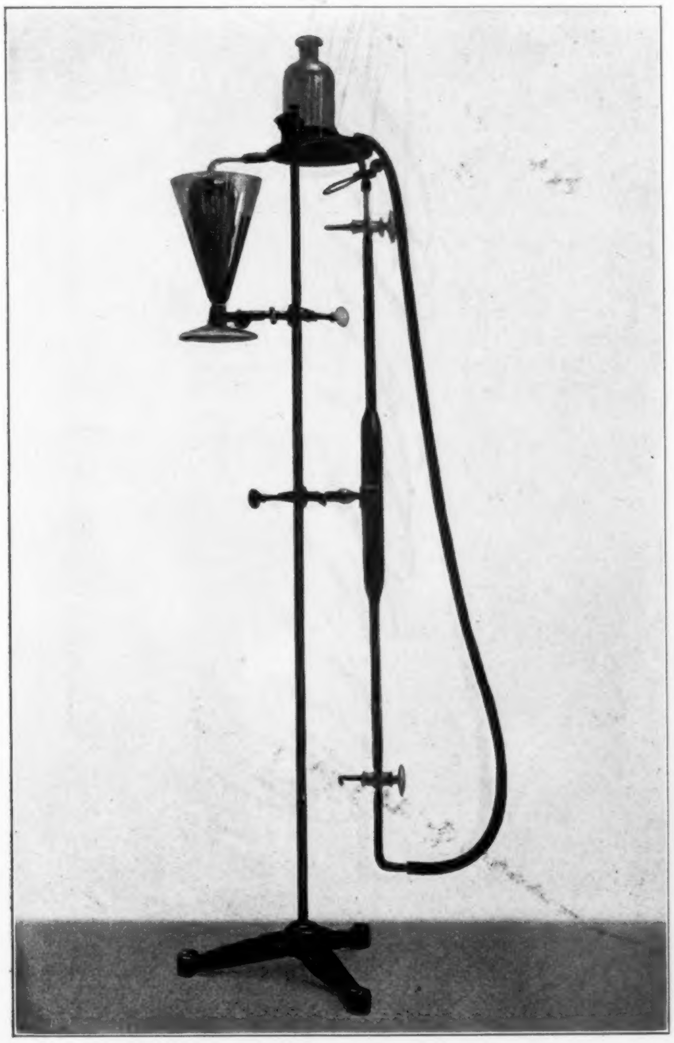


Metal Brake Step and Ratchet Wheel Used With Square Brake Shaft

chipping hammer always at hand. To meet these conditions a rivet buster has been developed by the Ingersoll-Rand Company, 11 Broadway, New York City, designed for use in its pneumatic riveting hammers. The end of this tool is interchangeable with the rivet set and when in use is held securely in place by the safety retaining spring used with the rivet set. The chisel end is of a size and shape found to be especially suitable for removing rivets, but it is also useful for removing burrs or other defects from the metal. It is of small size and may be readily carried in the workman's pocket, thus always being at hand when needed.

OXYGEN TESTING APPARATUS

A simple testing set for rapidly measuring the purity of oxygen has been introduced by the International Oxygen Company, 115 Broadway, New York. It is self-contained, has no complicated or expensive parts, and owing to the accessibility of all parts the liability to damage in cleaning is very small. The method of testing consists in the absorption of oxygen by copper in the presence of ammonia and ammonium carbonate and the removal of the cupreous oxide by the solution. The apparatus consists of a special burette having a three-way cock at either end, a special absorption pipette and a conical test glass within which the pipette is emersed. An aspirator bottle is connected to the lower end of the burette, and the pipette to the upper end of the burette by means of rubber tubing. A supporting rod and stand is provided to which the parts are secured by clamps as shown in the illustration. In operating the apparatus the pipette is first filled with 1/32 in. copper wire, after which it is emersed in a solution of ammonia and ammonium carbonate in the conical test glass. After all parts with the exception of the burette have been freed from air by the use of the aspirator bottle the burette is filled with oxygen through the top three-way cock, all air being driven out by opening the lower three-way cock to the atmosphere. After the burette has been filled with oxygen the three-way cocks are closed. By the use of the aspirator bottle the oxygen may then be forced into the pipette, where it is absorbed by the copper. When no further reduction in the volume of the gas takes place the remainder is drawn back into the burette, where the graduations of the scale are so arranged that the percentage of purity may be read directly to 0.1 per cent.

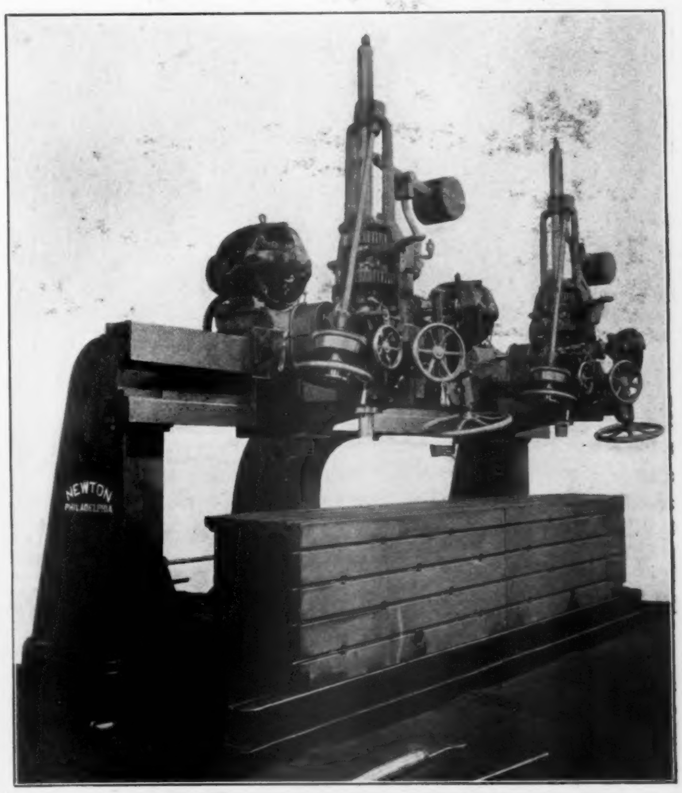


Apparatus for Determining the Purity of Oxygen

The operation of the apparatus is simple, no skilled labor being required to obtain accurate results. The ammonia-ammonium carbonate solution may be prepared without difficulty by following the directions furnished with the apparatus.

LOCOMOTIVE FRAME DRILL

A high duty locomotive frame drilling machine recently developed by the Newton Machine Works, Inc., Philadelphia, Pa., has several features not usually included in this class of machine. It is of exceptionally heavy box type construction intended to drive high speed drills to their maximum capacity, and has a weight of approximately 60,000 lb. The cross rail is rigidly supported by three uprights, the center one of which is placed back of the others to allow clearance for the top work table. This table, which is in two sections, is mounted on the main bed plate, and as shown in the illustration the sections may be moved back, either separately or in unison, to clear the main work table. This movement is controlled by a 5 hp. motor mounted on the back of the base.

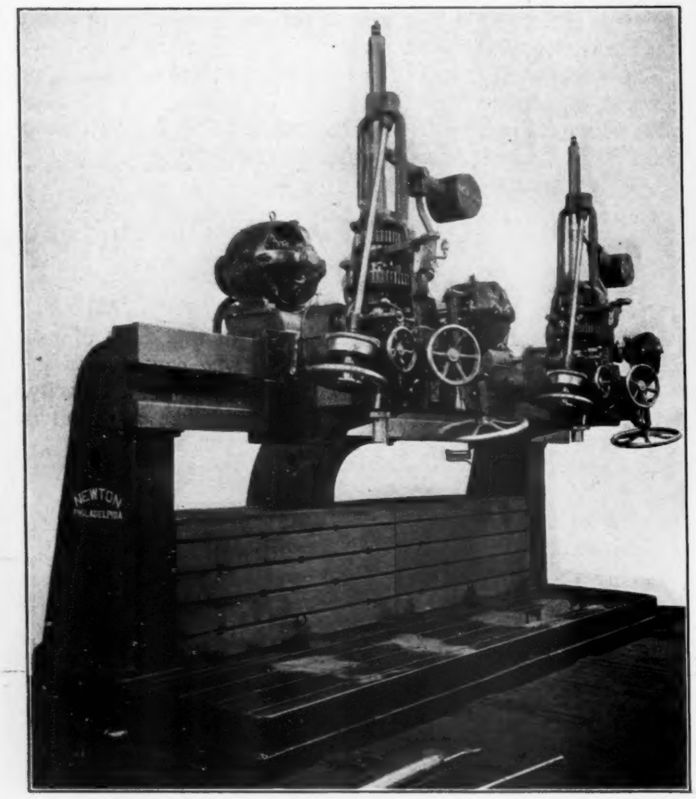


Frame Drill with Top Work Table in Forward Position

The machine has two spindles each driven by a 10 hp. General Electric motor having a speed range from 300 r. p. m. to 1,200 r. p. m. The motor is mounted on and travels with the saddle

and provides a fast reversing power traverse of the saddle on the rail in addition to the hand adjustment. The rail saddle extends forward at right angles to the rail, permitting an in-and-out adjustment of the spindle saddle by hand. The spindles are 4 in. in diameter with a vertical feed of 18 in.; they are counterweighted and have direct and back geared drive. Hand feed and hand adjustment are provided, in addition to four changes of gear feed without the removal of gears.

The maximum distance between the centers of the spindles is 15 ft., the minimum distance being 4 ft. The spindle saddles have an in-and-out adjustment of 15 in., the rear position of



Frame Drill with Top Work Table in Rear Position

the spindle center being $22\frac{1}{2}$ in. from the front of the top work table when in its rear position. The minimum distance from the end of the spindle to the top of the bed plate is $32\frac{1}{2}$ in. Each auxiliary work table is 36 in. high and has a top 30 in. wide by 7 ft. 6 in. long.

SHOP ILLUMINATION BY QUARTZ LAMPS

The accompanying illustrations show the interior of the boiler and erecting shops of the Lake Shore & Michigan Southern at Collinwood, Ohio. As will be noted the photographs were taken at night, and are evidence of an abundance of illumination at all points in the building without glare or shadows. The buildings are 528 ft. long and 58 ft. wide, giving an area of 30,624 sq. ft. in each. The illumination is furnished by the Westinghouse Electric & Manufacturing Company's type Z Cooper Hewitt Quartz lamps operating in a 220-volt direct current circuit. These lamps are a modification of the well-known Cooper Hewitt lamp, based on the same fundamental principles, but using a short tube of pure fused quartz.

Ten lamps are installed in the boiler shop, placed at regular intervals of 52 ft. down the middle of the building, each lamp lighting an average of 3,062 sq. ft. In the erecting shop there are twelve lamps regularly spaced down the middle of the building at intervals of 44 ft., giving an average floor area lighted by each lamp of 2,552 sq. ft. All the lamps are hung at a height of 50 ft. above the floor. The lamps are rated at 2,400 candle power each with an energy consumption of 725 watts, or a total for the installation of approximately 16 kilowatts.

The light afforded by these lamps is said to be sufficient for all purposes, even the locomotive pit being well illuminated. The

Lake Shore & Michigan Southern Erecting Shop at Collinwood, Ohio, Lighted with Cooper-Hewett Quartz Lamps

only other form of artificial light required is a portable hand lamp for use inside of boilers. When a trial installation of four lamps was first made, there was some antipathy to the light on the part of the men employed, because of the difference in color

Collinwood Boiler Shop, Showing the Distribution of Light

value, but this speedily disappeared after a thorough trial had been made, and the installation was completed. The lamps have been installed at various times, but the service of the entire installation averages practically 16 months and the maintenance charges for that period total $134.54, or $4.58 per lamp per year.

NEWS DEPARTMENT

Track foremen of the Philadelphia & Reading have been appointed fire wardens by the Pennsylvania State Department of Forestry.

The Atchison, Topeka & Santa Fe, on November 10, had the largest commercial freight loading in its history. A total of 5,229 cars were loaded on the entire system that day, compared with the previous record of 5,204.

The Chicago, Milwaukee & St. Paul cleaned and disinfected 5,000 stock cars between November 12 and November 23. It is also cleaning and disinfecting all its stock yards in quarantine territory, in accordance with government orders issued as a precaution against the spreading of the hoof-and-mouth disease.

The Wabash is printing on all of its working timetables a large "Safety Always" emblem and the following in large type: "Safety should be the first consideration of every employee. Every employee should report promptly to his foreman, some member of the safety committee or other proper person, every unsafe condition."

There are 77 men who have worked for the Pennsylvania Railroad 50 years or more and are young enough to be still busily working. Two of them have records of more than 56 years; two others have served 55 years; two, 54 years; seven, 53 years; six, 52 years, and twenty, 51 years. Of the 77 men five are conductors and eight are enginemen.

Four locomotives on the Louisville-St. Louis division of the Southern Railway are to bear the names of the enginemen who run them. The names will be painted in gilt letters, along with the number of the engine. The men who have been thus recognized are Frank Busching, William Hanafee, Robert Greenlaw and Daniel Shine. The requirement for the distinction is 25 years of efficient service.

The owners of the Altantic Southern, extending from Atlantic to Villisca, Iowa, 35 miles, have given public notice of their intention to discontinue operation on December 31, claiming that the road has been operated at a loss. It is reported that the people in the towns along the line are preparing to enter a protest before the State Railroad Commission against the closing of the line.

The Railroad Commission of Georgia, realizing the present serious financial predicament of the railroads, has written a letter to the Southern Railway to the effect that in view of the material decrease in the revenues of carriers the commission, until the present financial situation is relieved, will not impose on any of the roads any expenditures for new stations, warehouses, terminal facilities, etc., except such as are absolutely necessary.

The golden spike marking the closing of the last gap in the line of the Northwestern Pacific from San Francisco to Eureka, Cal., 283 miles, was driven at Cain Rock Crossing, Cal., 80 miles southeast of Eureka, on October 21, with appropriate ceremonies, and the first through passenger train was run over the line on the same day. The road is owned jointly by the Southern Pacific and the Atchison, Topeka & Santa Fe.

Postal service has been established on the Grand Trunk Pacific through to the Pacific Coast, and Prince Rupert now receives mail from the east in two days' less time than before. Hitherto the mails have been carried by steamer from Vancouver. The distance from Liverpool to Yokohama by way of the Grand Trunk and Prince Rupert is 10,085 miles, said to be 773 miles less than the distance by way of New York and San Francisco.

Following the election at which the voters of Missouri decisively defeated the full crew bill by referendum vote, the St. Louis & San Francisco announced that its shops at Springfield, Mo., would immediately be placed on a working basis of six days a week and eight hours a day. The main shops have been on a five-day schedule for several months and other shops have been operated only intermittently. Additional men also were given employment.

It has been decided to improve the opportunities of the apprentices at small terminals on the Grand Trunk, where it has not been possible to keep instructors. Correspondence courses, mapped out along approved lines, have been adopted for this purpose and the boys will be in touch in these studies with the headquarters in Montreal. Text books have been compiled, both in drawing and mechanics, and these have been made as practical as possible, so that the practical work may line up with the theory taught.

At the safety congress of the National Council for Industrial Safety, held in Chicago on October 14 and 15, there were present from the Chicago & Northwestern one delegate from each division, terminal shop and local safety committee, all making the trip as the guests of the company, 52 men in all. The delegates have adopted resolutions stating that they obtained much valuable knowledge and information at the meeting, which will be a great help in promoting the safety first work on the Northwestern; and thanking President Gardner and Vice-President Aishton for arranging the trip.

The National Transcontinental Railway, over which trains are running from Moncton, N. B., northwest to Escourt, 56 miles beyond Edmundston, is shortly to be put in operation between Moncton and Levis, opposite Quebec. Trains between Moncton and Escourt are operated by the Intercolonial and the Intercolonial will manage the extended service. The whole of the National Transcontinental is now finished, so as to be ready for use, but the arrangement by which the Grand Trunk Pacific was to operate the road appears to have encountered some obstacle. According to the Toronto World, the line west of Levis is likely not to be put in use until next spring.

Fairfax Harrison, president of the Southern Railway, speaking at Atlanta, Ga., recently, said that the severe retrenchment made necessary by the falling off in traffic would be continued, even to the extent of depriving passengers of some of the luxuries and conveniences which they have been accustomed to. The gross receipts of the railway company in September were 8.33 per cent less than in the same month of last year, and in October the decrease was 18.75 per cent. Curtailment of expenses has been necessary, in some cases, as a "war measure," even where it was uneconomical to make the reduction. Both the officers and the employees of the company have to stand serious losses. He believes that the present severe stress will be temporary and new construction work, provided for by capital which was raised last spring, has not been suspended.

Complete official figures show that the majority given by the voters of Missouri against the full crew bill was three times as great as was shown in the estimate based on the early returns; 324,085 votes against and 159,593 in favor, a majority of 164,492 in opposition to the bill. This makes the vote more than two to one against the law. Outside of the three principal cities, St. Louis, Kansas City and St. Joseph, the measure received only 86,660 votes in the state, and was beaten by a ratio of about three to

one. The farmers in every section of the state voted almost solidly against it. St. Louis, in which the Brotherhood looked for a big majority in favor of the bill, went against it by 18,417. In Kansas City and in St. Joseph it was carried. The majority against the bill is one of the greatest in the history of Missouri and is larger than the state has ever given to any candidate.

CORRECTION

In an article on the Four Feed Flange Oiler published in the November issue of the *Railway Age Gazette, Mechanical Edition,* on page 600, the name of the company manufacturing this device was incorrectly stated. It should have been the Ohio Injector Company, Monadnock building, Chicago, Ill.

TRAMPS BY THE TRAIN LOAD

A press despatch from San Bernardino, Cal., November 16, says that 93 tramps, on their annual winter tour westward, are in jail at that place, charged with having seized a San Pedro, Los Angeles & Salt Lake freight train on the Mojave desert. The tramps, more than a hundred strong, overpowered the trainmen, when the train entered Otis, broke the seals of freight cars and after making themselves comfortable, ordered the engineman to proceed to Los Angeles. A posse was waiting for the train at San Bernardino, and all but ten of the tramps were captured.

ARBITRATORS IN WESTERN ENGINEMEN'S AND FIREMEN'S CONTROVERSY

The arbitration board, to consider enginemen's and firemen's wages on the western roads, has finally been completed, after months of delay, and hearings have begun at Chicago. The arbitrators are: H. E. Byram, vice-president of the Chicago, Burlington & Quincy; W. L. Park, vice-president of the Illinois Central; F. A. Burgess, assistant grand chief of the Brotherhood of Locomotive Engineers; Timothy Shea, assistant to the president of the Brotherhood of Locomotive Firemen and Enginemen; Charles Nagel, ex-secretary of Commerce and Labor, and Jeter C. Pritchard, presiding judge of the United States Court of Appeals of the Fourth Circuit.

ELECTRIFICATION ON THE ST. PAUL

Construction work in connection with the electrification of the Chicago, Milwaukee & St. Paul between Harlowton, Mont., and Avery, Idaho, has been resumed. Thus far the poles have been placed for a distance of 30 miles on the 116-mile division between Three Forks and Deer Lodge, Mont., which is the first to be equipped. The company has ordered nine freight and three passenger electric locomotives from the General Electric Company. These locomotives will be of the same construction except that those to be used for passenger service will be geared for a higher speed. The total weight of these locomotives will be 519,000 lb. each, and the weight on drivers 400,000 lb. They are to be delivered in October, 1915, at which time, it is planned, the construction work over the entire line will have been completed.

CREDIT FOR SAVING SCRAP

Bulletins telling of specially meritorious acts on the part of employees have an added interest where the persons named in them are known; and the smaller the territory covered by a bulletin, the more likely are the employees generally to recognize the names published. W. T. Lechlider, superintendent of the Cleveland division of the Baltimore & Ohio, issues bulletins, once a month, or as often as may be found desirable, which are confined to happenings on his own division. One of the things noted in a recent bulletin was the commendation of a baggage master for making neat and comprehensive reports. The station forces at three places, and a dozen individual trainmen and section foremen were commended for saving scrap, the value of which, in two weeks, amounted to $218.

A DISHONEST CLAIM AGENT PUNISHED

In the United States District Court at Baltimore recently, George Elmer Long was convicted on five counts of defrauding the Baltimore & Ohio Railroad by bogus claims paid by Long while in the employ of the road. Long will serve three years in the federal penitentiary at Atlanta. He entered the employ of the Baltimore & Ohio about three years ago as a claim adjuster in the freight department, having had previous experience with southern roads. For some time after securing the position he was establishing himself in the confidence of superiors, after which, through the medium of confederates, a scheme of filing fraudulent claims was undertaken. The accomplices represented themselves as shipping concerns and made claims for losses or damage to shipments never shipped, and others which were shipped and contained only junk. In his confession Long admitted shipping four boxes as the property of different concerns. In most instances, however, no shipment was even made, the plan having been that where legitimate claims were adjusted the waybills were stolen and changed to cover shipments to firms existing only in the minds of the gang and on the stationery which they used. The claims varied usually in amounts ranging from $200 to $500. Long was tracked by Edmund Leigh, chief of the railroad detective force, the chase having been conducted in Pittsburgh, Niagara Falls, Hamilton, Chicago and Detroit. Long was arrested in Detroit while calling for mail at the post office.

OPENING OF THE KANSAS CITY UNION STATION

The new Union station of the Kansas City Terminal Railway, Kansas City, Mo., was formally dedicated with a two days' celebration, held under the auspices of the Kansas City Commercial Club. The mayor declared a half-holiday on Friday, October 30. The formal dedication of the station was held on Friday afternoon and the station was actually opened to traffic at 12:01 a. m., Sunday, November 1. The program on Friday began with a manufacturers' parade in the morning, consisting of 140 floats, 16 bands and motor cars carrying officers of the Commercial Club. The parade was nearly two miles long. In the afternoon was held a civic parade, including members of the principal commercial organizations of the city and representatives of the railways. Following this parade the opening was held at the station, when President H. H. Adams of the Kansas City Terminal Railway Company, formally presented the station to Kansas City. Mayor Jost responded with a speech of acceptance. In the evening a dinner was given by the Commercial Club to the officers of the railways at the Hotel Baltimore, and later in the evening a display of fireworks and a final illumination of the old station was given from the hill opposite the new Union Station. The Saturday program included a golf tournament for the visiting railway men, followed by a luncheon and a motor ride about the city.

It was estimated by the newspapers that the largest crowd ever assembled at Kansas City attended the opening of the new station. The dinner of the Commercial Club was attended by the presidents and other executive officers of the 12 roads which are partners in the new station, and by nearly 100 other prominent railway officers, and the principal city officers and business men of the city, including two former mayors of the city. Among the speakers were Hale Holden, president of the Chicago, Burlington & Quincy; B. F. Bush, president of the Missouri Pacific; B. L. Winchell, director of traffic of the Union Pacific; E. B. Pryor, receiver of the Wabash, and Gardiner Lathrop, general solicitor of the Atchison, Topeka & Santa Fe. Most of the speakers lauded the

railroads for their enterprise in building such a magnificent station, adequate to the demands of a city several times the size of Kansas City; and many speakers spoke of the justice of co-operating with the railroads in the future.

MEETINGS AND CONVENTIONS

International Railway General Foremen's Association.—William Hall, secretary-treasurer of the International Railway General Foremen's Association has changed his address from 914 to 1126 West Broadway, Winona, Minn.

International Railway General Foremen's Association.—An important meeting of the officers, and members of the executive committee of the International Railway General Foremen's Association, will be held at the Hotel Sherman, Chicago, Tuesday, December 8, 1914, at 10 a. m. As matters of great importance to the organization are to be considered, it is earnestly desired that all concerned will make an effort to be present.

New York Railroad Club.—At the meeting of the New York Railroad Club in New York on November 20, Frederick C. Syze, trainmaster of the Baltimore & Ohio at St. George, Staten Island, N. Y., was elected president, succeeding George W. Wildin. Other officers elected were: Burton P. Flory (N. Y. O & W.), first vice-president; James Milliken (P. B. & W.), second vice-president; A. J. Stone (Erie), third vice-president, and R. M. Dixon, treasurer. The report of the secretary shows that during the year the club had gained 318 new members and that on November 1, the membership was 2,364.

International Engineering Congress.—Announcement has been made of the program for the International Engineering Congress to be held in San Francisco, September 20 to 25, 1915, under the auspices of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers. In spite of the condition now prevailing in Europe the committee of management is in receipt of a sufficient number of communications from various foreign countries to indicate that a large majority of the papers originally requested for presentation at the sessions of the congress will be handed in on time and that the congress will be truly international in character. The total number of papers contemplated was about 290. Of this number about 220 are either definitely promised or well assured. The remainder, apportioned chiefly among the nations in the present war zone, are uncertain and it is expected that some of them will not be secured, but it is believed that by substituting for these others that have been offered the general plan for the congress may be carried out with a minimum of change.

Railway Business Association.—Fairfax Harrison, president of the Southern Railway, and Warren G. Harding, United States senator-elect from Ohio, are announced as the speakers for the sixth annual dinner of the Railway Business Association, the national organization of manufacturers, merchants and engineers dealing with steam railroads, which will be held at the Waldorf-Astoria hotel, New York, Thursday evening, December 10. The business meeting of the association will be held at 11 a. m. at the hotel, the election of officers at 1.30 p. m. and the dinner at 7, the doors opening exactly on the hour. The circular announcing the names of the speakers says in part:

"Mr. Harrison unites long experience and responsibility as a railway official with the oratorical art of the attorney. Practiced for many years in the study of public opinion as it affects the prosperity of the railways, he is a leader in the cultivation of friendly sentiment and cordial co-operation between railway managers and the people whom they serve.

"Mr. Harding is a journalist with substantial business interests. During several years of legislation affecting business and transportation he has given constant admonition, caution and counsel lest industry and commerce be shackled and the public welfare impaired. On that platform he has now been chosen by the people of Ohio as their senator in Congress. The obligation of government to promote national prosperity will furnish the keynote of his address, while his brilliant endowment as a writer and speaker complete the promise of a message appetizing in form as well as invigorating in substance.

"Subscribers to the dinner as this circular goes to press exceed those upon the corresponding date in 1913. Such response to an announcement not naming the speakers and at a time like the present is a display of enthusiasm by our members which proves anew their belief in the cause and their loyalty to the work."

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 5-7, 1915, Hotel Sherman, Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen building, Chicago. Convention, June 9-11, 1915, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois Central, Chicago. Convention, July 1915, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York. Convention, December 1-4, 1914, New York.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, except July and August, Lytton building, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 17-20, 1915, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn. Convention, July, 1915.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio. Convention, August 17, 1915, Philadelphia, Pa.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty street, New York. Convention, May 26-28, 1915, Chicago, Ill.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen building, Chicago. Convention, June 14-16, 1915, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass. Convention, September, 14-17, 1915, Detroit, Mich.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane building, Buffalo, N. Y. Meetings monthly.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio. Convention, May 17-19, 1915, Hotel Sherman, Chicago.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, September 1915, Chicago, Ill.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Dec. 8	Maximums and Minimums in Train Operation	A. Price	James Powell	Room 13, Windsor Hotel, Montreal.
Central	Jan. 8	Electric Railway Night		Harry D. Vought.	95 Liberty St., New York City.
New England	Dec. 8	European War and Its Effect on Business.	W. R. Balch	Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Dec. 18	Annual Smoker		Harry D. Vought.	95 Liberty St., New York City.
Pittsburgh		Notes on Transportation in Europe	A. Stucki	J. B. Anderson	207 Penn. Sta., Pittsburgh, Pa.
Richmond	Dec. 14	A Talk by the Presidents of C. & O. and R. F. & P.		F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Dec. 11	Benefits of the Relief Department to a Railway	S. R. Parr	B. W. Frauenthal.	Union Station, St. Louis, Mo.
Southern & S'w'rn	Jan. 21	Electric Welding		A. J. Merrill	218 Grant Bldg., Atlanta, Ga.
Western	Dec. 15	The Possibility of Fire from Locomotive Sparks	Prof. L. W. Wallace.	Jos. W. Taylor	1112 Karpen Bldg., Chicago, Ill.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

H. C. OVIATT, until recently superintendent of the Old Colony division of the New York, New Haven & Hartford, has been appointed assistant mechanical superintendent in charge of the Bureau of Fuel Economy, just established, with office at New Haven, Conn.

J. J. SULLIVAN has been appointed superintendent of machinery of the Nashville, Chattanooga & St. Louis, with headquarters at Nashville, Tenn., to succeed A. G. Kantman, resigned to devote his time to private affairs.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

H. B. HAYES, master mechanic of the Cincinnati, New Orleans & Texas Pacific at Somerset, Ky., has been transferred to Birmingham, Ala., as master mechanic of the Alabama Great Southern.

W. E. MOHER has been appointed traveling locomotive foreman of the Grand Trunk Pacific, with headquarters at Transcona, Man.

H. F. STALEY, formerly master mechanic of the Carolina, Clinchfield & Ohio, has been appointed master mechanic of the Boyne City, Gaylord & Alpena at Boyne City, Mich.

A. STURROCK has been appointed district master mechanic of the Canadian Pacific, with office at Nelson, B. C., succeeding A. Mallinson.

CAR DEPARTMENT

T. J. BUTLER has been appointed car foreman of the Rock Island Lines at Herington, Kan., succeeding A. L. Clem, promoted.

J. L. CANTWELL has been appointed general foreman of the Southern Railway at Asheville, N. C. He entered the service of Southern Railway as machinist at Birmingham in January, 1906, which position he held until June of the same year, when he was appointed erecting shop foreman. He was transferred to Inman as assistant foreman in October, 1906, and returned to Birmingham in December of the same year as erecting shop foreman. In January, 1909, he was promoted to general foreman at Princeton, Ind., which position he held until he was transferred to Asheville as general foreman.

J. S. EASTERLY, chief car inspector of the Southern Railway at Citico, Tenn., has been promoted to foreman of the freight car repairs at the Coster (Tenn.) shop.

J. F. LEAKE, formerly foreman of freight car repairs at the Coster, Tenn., shop of the Southern Railway, has been appointed chief joint inspector at Chattanooga, Tenn., representing the Alabama Great Southern; Cincinnati, New Orleans & Texas Pacific and Southern.

W. D. LYLE, a car inspector of the Southern Railway, has been appointed chief car inspector at Citico, Tenn.

W. F. WEIGMAN has been appointed general foreman of the car department on the Charleston & Western Carolina, with headquarters at Augusta, Ga.

SHOP AND ENGINE HOUSE

W. H. BURLEIGH has been appointed roundhouse foreman of the Rock Island Lines at Armourdale, Kan.

A. M. LAWHON has been appointed general foreman of the Southern Railway at Princeton, Ind. He entered railroad service as machinist in September, 1890. In September, 1899, he was promoted to night roundhouse foreman, serving in this capacity for three years, and as day roundhouse foreman for six years, when he resigned. He re-entered the service of the Southern Railway as machinist at Coster, Tenn., October, 1912, and one year later was promoted to assistant roundhouse foreman, which position he held three months, being transferred to Princeton as erecting and machine shop foreman, holding this position until his appointment as general foreman.

J. H. ORTH has been appointed machine shop foreman of the Southern Railway at Princeton, Ind.

D. E. SMITH, formerly locomotive foreman of the Grand Trunk Pacific at Biggar, Sask., has been appointed locomotive foreman at Regina, Sask., succeeding A. S. Wright.

W. B. TROW has been appointed general foreman of the Rock Island Lines at Armourdale, Kan., succeeding E. P. Eich, assigned to other duties.

A. S. WRIGHT, formerly locomotive foreman of the Grand Trunk Pacific at Regina, Sask., has been appointed locomotive foreman at Biggar, Sask., succeeding D. E. Smith.

PURCHASING AND STOREKEEPING

O. NELSON has been appointed traveling storekeeper of the Union Pacific, with headquarters at Omaha, Neb.

A. E. YUILL has been appointed tie and timber agent of the Canadian Northern, with jurisdiction over eastern lines, with headquarters at Toronto, Ont.

OBITUARY

JAMES BISSETT, formerly master mechanic of the South Side shops of the St. Louis & San Francisco at Springfield, Mo., died in Springfield, November 11, after an operation. Mr. Bissett was born in Dunfermline, Scotland, May 15, 1840, and came to the United States with his parents when he was 10 years old. He entered railway service at the age of 14 as a water boy on the North Madison Railway at North Madison, Ind., and later entered the railway shops there where he received his early training as a machinist. His next position was that of locomotive fireman, and with the outbreak of the Civil War Mr. Bissett enlisted and was detailed to a railway corps of the Confederate army. He served during the war, and afterwards was in the employ of a number of railways in the United States until October, 1899, when he opened what are now known as the South Side shops of the Frisco, this part of the system at that time being the Kansas City, Ft. Scott & Memphis. He remained as master mechanic of these shops until two years ago when he retired on a pension.

NEW SHOPS

GRAND TRUNK PACIFIC.—A contract has been given to Carter, Halls & Alinger, Winnipeg, Man., at $300,000, it is said, for constructing terminals at Prince George, at Endako, at Smithers and at Pacific. The construction work has already been started and will include roundhouses, machine shops and other railway buildings. The company will probably let a contract soon for similar work at Prince Rupert, the coast terminus.

SOUTHERN RAILWAY.—This company will start work at once on new engine terminal facilities at Denverside, near East St. Louis, at a cost of about $275,000, and is asking for bids for the construction of an 18-stall roundhouse, shops and other buildings. The improvements also include a 90-ft. turntable, modern coal and cinder handling plant, oil house, office building, etc., and the construction of repair yard tracks and other track work. The grading work for the tracks is now under way.

SUPPLY TRADE NOTES

C. E. Harrison has resigned as co-receiver of the Barney & Smith Car Company, and H. M. Estabrook will continue as sole receiver.

The American Car & Foundry Company has announced that its plants at St. Louis, Mo., and Madison, Ill., will be closed on December 1.

H. C. Hequembourg, having resigned as general purchasing agent of the American Locomotive Company, the purchasing and storekeeping departments will be under the jurisdiction of Leigh Best, vice-president.

Eli F. Hart, one of the founders and the chairman of the board of the Rodger Ballast Car Company, Chicago, died at his home in Chicago on November 23. Mr. Hart was born at Rochester, N. Y., in 1832.

After sixteen years service with Hermann Boker & Co., New York, Ellsworth Haring has terminated his connection with that company, and has organized a business in tool steel and related specialties, with temporary offices at 684a Hancock street, Brooklyn, N. Y.

J. A. Smythe has been appointed boiler expert of the Lukens Iron & Steel Company, and the Jacobs-Shupert U. S. Firebox Company, with headquarters at Coatesville, Pa. Mr. Smythe was formerly associated with the Parkesburg Iron Company, Parkesburg, Pa., in a similar capacity.

A. L. Moler has been elected vice-president, manager and a director of the Durbin Train Pipe Connector Company, Ltd., Montreal, Que. Mr. Moler has been connected with several large railways as master mechanic and superintendent of motive power in the course of the past 16 years.

H. C. Hequembourg, who has been the general purchasing agent of the American Locomotive Company since its organization, has resigned to accept the vice-presidency of the Standard Chemical Company, Pittsburgh, Pa. This company is said to be the largest producer of radium in the world.

W. E. Magraw, president and treasurer of the Railway List Company, the Railway Master Mechanic, and Railway Engineering and Maintenance of Way, Chicago, died on Tuesday, November 24, following an operation for appendicitis. Mr. Magraw was born in St. Peter, Minn., in 1858, and was for many years western advertising manager of the Railway Review. He leaves a widow and two daughters.

Dr. J. A. L. Waddell and John Lyle Harrington announce the dissolution of the firm of Waddell & Harrington, consulting engineers, Kansas City, Mo. The firm's business will be conducted as usual till the conclusion of its affairs in July, 1915, except that it is accepting no new commissions. Dr. Waddell will give his attention to special engineering and financial matters, and to important advisory work. Mr. Harrington will become a member of the new firm of Harrington, Howard and Ash, as noted elsewhere.

John Lyle Harrington, E. E. Howard and Louis R. Ash have established the firm of Harrington, Howard & Ash, with office in the Orear-Leslie building, Kansas City, Mo., and will conduct a general consulting practice relating to hydro-electric developments, advisory municipal engineering appraisals, examinations, and reports upon engineering projects, giving special attention to foundations, bridges—particularly movable spans—and other structures in steel and reinforced concrete. Mr. Harrington spent many years in bridge and structural shops, two of which he designed and operated, in the service of railroad companies, and in mechanical and electrical work. For three years he was the executive engineer of the C. W. Hunt Co., New York, and for two years chief engineer and manager of the Locomotive & Machine Company of Montreal. For the past eight years he has been a member of the recently dissolved firm of Waddell & Harrington, consulting engineers, Kansas City, and has directed the design and construction of many bridges. Mr. Howard has been associated with Dr. J. A. L. Waddell for fourteen years, for many years as principal assistant engineer, and later as associate engineer of Waddell & Harrington. His experience covers every phase of the firm's work. Mr. Ash has had many years' experience in engineering work, and from July, 1910, to April, 1913, was city engineer of Kansas City, in which capacity he was responsible for the design and construction of sewers, paving, grading, flood protection work, etc. He also made an appraisal of the property of the Metropolitan Street Railway Company, and was engineering adviser for the city in the street railway franchise negotiations. Mr. Ash resigned from the position of city engineer to become associate engineer and office manager of Waddell & Harrington.

George W. Lyndon has been elected president of the Association of Manufacturers of Chilled Car Wheels, with headquarters at Chicago. Mr. Lyndon was born at Rochester, N. Y., February 16, 1859. He attended the Kewanee, Ill., high school, graduating in 1877. He was then a law student with Charles K. Ladd, Kewanee, and Turner A. Gill, Kansas City, Mo., until 1880, when he entered railway service with the Kansas Pacific at Kansas City, Mo. shortly thereafter he was transferred to Omaha on account of the consolidation of the Kansas Pacific with the Union Pacific. He remained with the Union Pacific as chief clerk of freight accounts until 1885, then accepted a position as traveling auditor of the Kansas City, Fort Smith & Memphis, with headquarters at Kansas City. In 1887 he was appointed freight auditor, resigning in 1889 to accept a position as freight auditor of the Chicago, Kansas City & St. Paul, now the Chicago Great Western. In 1890 he resigned to take a position as general auditor of the Griffin Wheel Company and Ajax Forge Company. Later he was made manager of the improvement and review departments, which position he held until 1907. In 1908 he was made western secretary of the Railway Business Association, and in the same year he accepted a position as secretary and treasurer of the Association of Manufacturers of Chilled Car Wheels, which position he held until his election as president on October 27.

G. W. Lyndon

THE SAFETY MOVEMENT IN ENGLAND.—The Great Western, of England, recently presented to each of its 80,000 employees a 48-page pamphlet entitled "The Safety Movement." The introduction gives the railway accident statistics for the United Kingdom, showing what proportion were due to want of caution by the men themselves. The book contains many illustrations showing both safe and dangerous methods of doing work on locomotives and rolling stock, in yards and shops, in baggage rooms, on tracks, etc. Safety devices such as goggles and respirators are also described. At the end of the book is a tabulation of one month's personal accidents in the various departments of the railway, accompanied by an appeal to all employees to assist in the safety movement.

Catalogs

Fire Shovels.—Circular No. 53, issued by the National Malleable Castings Company, Cleveland, Ohio, deals with the malleable iron fire shovels manufactured by this company. Illustrations and a table of dimensions are included.

Electric Switchboards.—Bulletin S1, issued by the Western Electric Company, 463 West street, New York, is devoted to Western Electric switchboards, and has been issued especially for the Central and South American trade. It is completely illustrated.

Gate Valves.—Jenkins Brothers, 80 White street, New York, have recently issued a folder on the subject of Jenkins Brothers brass gate valves. This folder contains a number of illustrations showing the various forms and sizes of these valves, with reference numbers.

Kewanee Union.—A four page leaflet issued by the National Tube Company, Pittsburgh, Pa., is devoted to the male and female pattern Kewanee union. The leaflet states a number of the advantages claimed for this type of union, as well as other data concerning it.

Portable Voltmeter.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 46,018, describing this company's portable voltmeter known as type P-8. This is an unusually small instrument and is suitable for use on both alternating and direct currents.

Power Hammers.—A pamphlet issued by Beaudry & Company, 141 Milk street, Boston, Mass., is descriptive of the Champion and Peerless power hammers manufactured by this company. The pamphlet contains illustrations of the hammers as well as tables giving the various sizes and dimensions.

Gas-Electric Motor Cars.—Bulletin No. 44,300 from the General Electric Company, Schenectady, N. Y., illustrates and describes some of the gas-electric motor cars and locomotives built by this company. These cars and locomotives are adapted to branch line service on steam roads and also for interurban service.

Small Motors.—The General Electric Company, Schenectady, N. Y., has just issued bulletin No. 41,500, describing the small direct and alternating current motors of the drawn shell type manufactured by this company. These are fractional horsepower motors which have been specially designed for diversified forms of small machines.

Electric Train Operation.—Train operation for city, suburban and interurban service, is the subject of a booklet recently issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. This includes illustrations of a large number of cars and trains which are equipped with Westinghouse electrical apparatus.

Boiler Tube Cleaners.—A four page leaflet issued by the William B. Pierce Company, 45 North Division street, Buffalo, N. Y., illustrates and describes the Dean boiler tube cleaner. A description of the method of operation is given and there is also included a drawing showing the use of the steam tube cleaner in brick arch supporting tubes.

Heating and Ventilating System.—A 16 page booklet, issued by the American Blower Company, Detroit, Mich., illustrates and describes the heating, ventilating and cooling system of the Sirocco type installed in the plant of the Ford Motor Company, Detroit, Mich. A page is also devoted to the various types of blowers manufactured by this company.

Coaling Stations.—A four page pamphlet issued by the Roberts & Schaefer Company, Chicago, deals with the Holmen coaling plant. A halftone illustration is included showing the coaling station recently erected at the clearing yard of the Chicago & Western Indiana near Chicago, and a number of other illustrations and reproductions from drawings are also included.

Valves.—A pamphlet recently issued by the Golden-Anderson Valve Specialty Company, Fulton building, Pittsburgh, Pa., illustrates a number of different types of valves manufactured by this company. These include double cushion, triple acting, non-return valves; quick closing stop valves; combined throttle and automatic engine stop valves and automatic water service valves.

Alternating Current Generators.—Bulletin No. 40,500 from the General Electric Company, Schenectady, N. Y., is devoted to the subject of alternating current generators for direct connection to reciprocating engines. This bulletin illustrates and describes some of the recent improvements in the alternators built by this company for direct connection to steam, oil and gas engines.

Axle Lighting Equipment.—The Safety Car Heating & Lighting Company, 2 Rector street, New York, has issued a catalog bearing the date of October, 1914, on the operation of Safety axle driven car lighting equipment. This catalog contains 35 pages and illustrates in detail the Safety axle driven system. It also includes instructions pertaining to the operation of the equipment.

Commutating Pole Railway Motors.—Bulletin No. 44,404, issued by the General Electric Company, Schenectady, N. Y., describes ventilated commutating pole motors manufactured by this company. These motors have a rated capacity of 80 hp. on 600 volts, but because of induced ventilation, a greater service capacity than motors of the closed type having the same hourly rating is claimed for them.

Dynamometers.—Bulletin No. 48,701 superseding bulletin No. 112 from the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth street, New York, is devoted to the subject of Sprague Electric dynamometers. A large number of illustrations are included, as well as descriptive matter pertaining to the different types of equipment which may be tested by these dynamometers.

Heat Treating Furnaces.—Bulletin No. 6 from the Quigley Furnace & Foundry Company, Springfield, Mass., is devoted to overfired, accurate temperature, heat-treating furnaces using gas or oil as fuel. These furnaces are intended for economically heating and handling material, annealing, hardening, tempering, carbonizing, etc., where uniform and controllable temperature is required. The bulletin contains a number of illustrations.

Boiler Circulation.—The Q & C Company, 90 West street, New York, has issued a catalog describing the Ross-Schofield system of circulation for locomotive boilers. This catalog is handsomely gotten up and is illustrated with photographs and colored engravings. The system has been installed on stationary boilers on the Philadelphia & Reading, as well as on locomotive boilers on that road and on the New York, Ontario & Western.

Electric Railway Apparatus.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 44,003, devoted to modern electric railway apparatus. This bulletin is attractively gotten up and is thoroughly illustrated. It briefly describes the Curtis steam turbine for railway service, railway generators, transformers, switchboards, ventilated railway motors, electric locomotives, etc., and contains illustrations of the electric locomotives in use at the locks of the Panama Canal.

Substation Equipment.—Among the recent publications of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is circular No. 1,550, which is devoted to 1,500-volt direct current substation equipment. Descriptions are given of a number of electric railroads throughout the country which are using this type of equipment, several of which are well illustrated with maps and photographs.